

DRILLING WATER QUALITY

During the drilling program, samples of ground water are taken from specified intervals for analysis. A summary of the resulting water quality data is presented in the following Tables II B-5 through II B-14.

The data are presented for the depth at which the drilling bit was located when the water sample was taken. Since the sample was taken from the drilling water flow line, the data presented reflect composite conditions throughout the hole from the surface to sample depth.

All samples were analyzed for major and minor constituents, trace metals, radioactivity and total organic carbon. Major constituent analysis is regularly prepared by three different laboratories: TOSCO, Industrial Laboratories, and Commercial Testing and Engineering. Minor constituents and metals are analyzed by the latter two laboratories. Trace metal analyses and total organic carbon analyses are prepared by Commercial Testing and Engineering. Radioactivity is analyzed by Hazen Research, Inc.

Since some of the analyses are duplicated on the same sample by two or more laboratories, a comparison of independent analytical results is possible in some cases. All of the lab reports from each laboratory are included here for comparison following Tables II B-5 through II B-14. The single set of results for each element in the summary tables are the result of our critical evaluation of which laboratory used the best analytical methods where two or more labs performed the same analysis. For example, one laboratory's atomic absorption method appears more accurate for the more common metals than another laboratory's spark source method since the spark source method has a tendency to consume the salts so that readings on elements such as Boron would be too low.



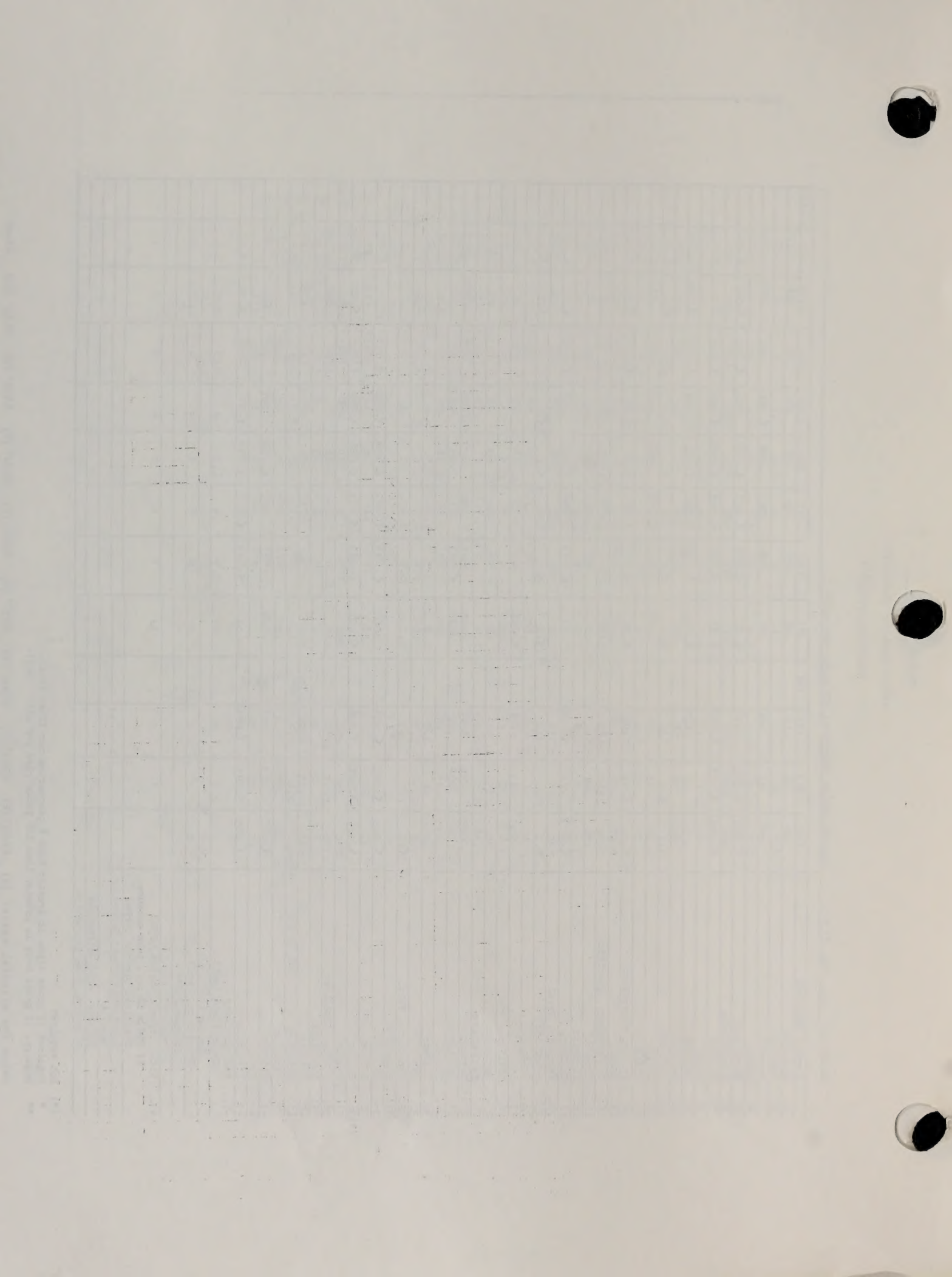
TABLE
WATER QUALITY ANALYSIS
ALLUVIAL WELLS (a)

Location: See Fig. II B-1 (unless stated otherwise, all units are mg/l)

Element Measured	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1. Aluminum	32	34	14		.06	.05	.05	.05			.52	.17	
2. Ammonia	1	6	1		.1	.1	.1	.04			.1	.1	
3. Arsenic	.005	.01	.004		.05	.04	.02	.04			.009	.01	
4. Barium	0.2	0.1	0.2		.06	.03	.03	.04			.05	.05	
5. Beryllium	.001	.001	.001		.01	.003	.003	.008			.02	.02	
6. Bicarbonate	563	586	562		516	670	405	630			475	585	
7. Bismuth	.005	.003	.006		.01	.003	.003	.008			.02	.02	
8. Boron	.6	1.7	.7		1.2	1.4	1.4	.07			.6	.6	
9. Cadmium	.01	.12	.016		.001	.003	.003	.001			.002	.002	
10. Calcium	80	52	58		36	30	16	56			61	103	
11. Carbonate	1	1	1		1	1	1	1			1	1	
12. Cerium	0.02	.01	.02		.007	.01	.003	.006			.01	.01	
13. Chloride	15	10	7.6		15	17	11	3.5			4.2	3.5	
14. Cobalt, Hexavalent	.01	.01	.01		.01	.01	.01	.01			.01	.01	
15. Cobalt	0.02	.05	.02		.04	.004	.03	.002			.05	.05	
16. Conductivity, Specific	1790	1240	1180		1480	1540	1180	1400			1480	1510	
17. Copper	.05	.03	.01		.1	.09	.04	.07			.2	.03	
18. Fluoride	3.4	5.0	1.9		1.5	1.9	8.0	.8			.5	.7	
19. Gallium	.005	.01	.006		.03	.003	.002	.007			.02	.02	
20. Hardness, Total	530	395	330		352	360	122	386			502	478	
21. Hydroxide	1	1	1		1	1	1	1			1	1	
22. Iron	2.4	3.5	.05		.05	.05	.05	.05			1.3	2.8	
23. Lead	.03	.03	.03		.001	.01	.05	.07			.2	.05	
24. Lithium	4	3	5		.5	.5	.5	.5			.5	.5	
25. Magnesium	80	65	45		64	70	20	60			85	53	
26. Manganese	.96	1.5	2.2		2.3	.12	.74	2.1			.52	.09	
27. Mercury	.003	.002	.003		.001	.0017	.002	.002			.0003	.0002	
28. Molybdenum	.02	.005	.02		.02	.003	.01	.04			.02	.02	
29. Nickel	.05	.05	.07		.09	.02	.02	.01			.01	.01	
30. Nitrate	.3	.6	3.0		2.2	3.5	4.3	3.5			3.1	2.9	
31. Phosphate	7.8	7.4	7.5		7.8	7.4	8.4	7.6			7.4	7.3	
32. Potassium	1.1	1.1	.3		0.2	0.3	0.4	.1			.1	.1	
33. Selenium	.005	.003	.006		.06	.003	.003	.008			.02	.02	
34. Silver	17	22	18		17	20	41	16			14	15	
35. Silica	.005	.003	.006		.001	.003	.003	.008			.02	.02	
36. Sodium	270	255	250		290	295	375	290			185	730	
37. Sulfate	1330	1110	1050		1215	1170	1166	1218			1062	1179	
38. Strontium	1	2	2		4	3	2	3			3	3	
39. Sulfate	530	415	400		500	405	475	480			475	480	
40. Titanium	1	0.4	0.7		1	.08	0.1	.2			.2	.04	
41. Vanadium	.02	.02	.01		.03	.002	.006	.01			.01	.01	
42. Vanadium	.005	.003	.006		.004	.001	.001	.008			.02	.02	
43. Zirconium	.5	.05	.3		.1	.2	.06	.5			.04	.5	
44. Zirconium	.005	.005	.006		.01	.003	.003	.008			.02	.02	
45. Radioactivity	4.3	2.3	0		0	2.9	14	1.5			5.0	1.6	
Gross Alpha (pci)	0.2					0.3					0		
Gross Beta (pci)	0	0	0		0	0	0	0			0	0	
Uranium 230**													
Uranium 235**													
47. Total Organic Carbon (TOC)	7	7	7		7	7	8	8			3	3	
If TOC > 10 mg/l then measure													
Dissolved Organic Carbon													
Suspended Organic Carbon													
Phenols													
Sulfate, Acid Extraction													
Nitrogen, Base Extraction													

(*) Not required
 * Required if gross alpha is greater than 4 picocuries per liter (pci).
 ** Required if gross beta is greater than 100 picocuries per liter (pci).

Datum for alluvial wells: (1) 6200' (2) 6200' (3) 6340' (5) 6257' (6) 6268' (7) 6282' (8) 6330' (9) 6481' (10) 6542'
 (Ground Level Elevation)
 (a) All samples were taken October 9-10, 1974.



WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1 (Unless otherwise stated, all units are mg/l)

Location: 1417.3 FSL & 1588.3 FWL Sec. 7T3SR96W Elevation: 6909 Grd.

Element Measured		Depth at Which Sample Taken (ft.)			
		952			
1.	Aluminum	18			
2.	Ammonia	.39			
3.	Arsenic	.2			
4.	Barium	.04			
5.	Beryllium	<.001			
6.	Bicarbonate	357			
7.	Bismuth	<.001			
8.	Boron	.01			
9.	Cadmium	<.001			
10.	Calcium	32			
11.	Carbonate	7			
12.	Cerium	<.001			
13.	Chloride	0.9			
14.	Chrome, Hexavalent	<.01			
15.	Cobalt	.04			
16.	Conductivity, Specific				
17.	Copper	.1			
18.	Fluoride	2.1			
19.	Gallium	.001			
20.	Hardness, Total	190			
21.	Hydroxide	<.1			
22.	Iron	6			
23.	Lead	<.001			
24.	Lithium	.04			
25.	Magnesium	24			
26.	Manganese	.01			
27.	Mercury	<.01			
28.	Molybdenum	.03			
29.	Nickel	.02			
30.	Nitrate	.21			
31.	pH	8.5			
32.	Phosphate, Total	.05			
33.	Potassium	.6			
34.	Selenium	<.001			
35.	Silica	21			
(*) 36.	Silver	<.001			
37.	Sodium	136			
38.	Solids, Dissolved	582			
39.	Strontium	6			
40.	Sulfate	183			
41.	Titanium	0.1			
42.	Vanadium	.01			
43.	Yttrium	<.001			
44.	Zinc	.09			
45.	Zirconium	.001			
46.	Radioactivity				
	Gross Alpha (pcl)	13			
	Radium 226*	2.3			
	Gross Beta (pcl)	8			
	Thorium 230**				
	Uranium**				
47.	Total Organic Carbon (TOC)	7			
	If TOC > 10 mg/l then measure				
	Dissolved Organic Carbon				
	Suspended Organic Carbon				
	Phenols	<.001			
	Sulfate, Acid Extraction				
	Nitrogen, Base Extraction				
48.	Cyanide	<.01			

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1A (Unless otherwise stated, all units are mg/l)
 Location: 1369.2FSL&1512.7FWL Sec. 7T3SR96W Elevation: 6909 Grd.

Element Measured	Depth at Which Sample Taken (ft.)			
	960	1344	1424	1620
1. Aluminum	0.1	✓	✓	2
2. Ammonia	1.9		1.6	2.2
3. Arsenic	0.05	<.01	<.01	<.01
4. Barium	0.01	<1.0	<1.0	0.06
5. Beryllium	<.1	<.1	<.1	<.1
6. Bicarbonate	337	570	586	583
7. Bismuth	<.001	✓	✓	<.001
8. Boron	2.4	0.6	4.1	0.1
9. Cadmium	<.01	<.01	<.01	<.01
10. Calcium	11	10	11	10
11. Carbonate	4	12	14	14
12. Cerium	<.001	✓	✓	<.001
13. Chloride	4	3	2.1	2.2
14. Chrome, Hexavalent	<.01	<.01	<.01	<.01
15. Cobalt	0.007			0.007
16. Conductivity, Specific				
17. Copper	<.1	<.1	<.1	<.1
18. Fluoride	.9	14	15	17
19. Gallium	0.001	✓	✓	0.002
20. Hardness, Total	96	64	64	54
21. Hydroxide	<.1	<.1	<.1	<.1
22. Iron	<.05	<.05	<.05	<.05
23. Lead	.003	<.05	<.05	.003
24. Lithium	0.6	<0.5	<0.5	<0.5
25. Magnesium	21	6	6	5
26. Manganese	0.05	<.05	<.05	<.05
27. Mercury	.0005	<.01	<.01	
28. Molybdenum	0.09	<.1	<.1	.05
29. Nickel	0.02	✓	✓	0.02
30. Nitrate	0.46	<0.1	<0.1	<0.1
31. pH	8.3	8.5	8.5	8.4
32. Phosphate, Total	<0.1	0.3	<0.1	<0.1
33. Potassium	0.3	0.5	0.5	0.5
34. Selenium	0.002	<.01	<.01	<.01
35. Silica	24	13	13	13
(*) 36. Silver	.001	.01	.01	.01
37. Sodium	156	248	250	246
38. Solids, Dissolved	581	633	638	617
39. Strontium	1	✓	✓	0.7
40. Sulfate	195	47	39	24
41. Titanium	0.01	✓	✓	0.07
42. Vanadium	0.003	✓	✓	0.001
43. Yttrium	<.001	✓	✓	<.001
44. Zinc	.03	<.5	<.5	.09
45. Zirconium	<.001	✓	✓	<.001
46. Radioactivity				
Gross Alpha (pci)	✓	✓	✓	5.9
Radium 226*				0.3
Gross Beta (pci)	✓	✓	✓	7.0
Thorium 230**				
Uranium**				
47. Total Organic Carbon (TOC)				8
If TOC > 10 mg/l then measure				
Dissolved Organic Carbon				
Suspended Organic Carbon				
Phenols	<.003	<.001	<.001	<.001
Sulfate, Acid Extraction				
Nitrogen, Base Extraction				

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pci).

** Required if gross beta is greater than 100 picocuries per liter (pci).

✓ insufficient sample to determine

Date				Time			
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64
65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104
105	106	107	108	109	110	111	112
113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128
129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152
153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184
185	186	187	188	189	190	191	192
193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208
209	210	211	212	213	214	215	216
217	218	219	220	221	222	223	224
225	226	227	228	229	230	231	232
233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248
249	250	251	252	253	254	255	256
257	258	259	260	261	262	263	264
265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296
297	298	299	300	301	302	303	304
305	306	307	308	309	310	311	312
313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328
329	330	331	332	333	334	335	336
337	338	339	340	341	342	343	344
345	346	347	348	349	350	351	352
353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368
369	370	371	372	373	374	375	376
377	378	379	380	381	382	383	384
385	386	387	388	389	390	391	392
393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408
409	410	411	412	413	414	415	416
417	418	419	420	421	422	423	424
425	426	427	428	429	430	431	432
433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448
449	450	451	452	453	454	455	456
457	458	459	460	461	462	463	464
465	466	467	468	469	470	471	472
473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488
489	490	491	492	493	494	495	496
497	498	499	500	501	502	503	504
505	506	507	508	509	510	511	512
513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528
529	530	531	532	533	534	535	536
537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552
553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568
569	570	571	572	573	574	575	576
577	578	579	580	581	582	583	584
585	586	587	588	589	590	591	592
593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608
609	610	611	612	613	614	615	616
617	618	619	620	621	622	623	624
625	626	627	628	629	630	631	632
633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648
649	650	651	652	653	654	655	656
657	658	659	660	661	662	663	664
665	666	667	668	669	670	671	672
673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688
689	690	691	692	693	694	695	696
697	698	699	700	701	702	703	704
705	706	707	708	709	710	711	712
713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728
729	730	731	732	733	734	735	736
737	738	739	740	741	742	743	744
745	746	747	748	749	750	751	752
753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768
769	770	771	772	773	774	775	776
777	778	779	780	781	782	783	784
785	786	787	788	789	790	791	792
793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808
809	810	811	812	813	814	815	816
817	818	819	820	821	822	823	824
825	826	827	828	829	830	831	832
833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848
849	850	851	852	853	854	855	856
857	858	859	860	861	862	863	864
865	866	867	868	869	870	871	872
873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888
889	890	891	892	893	894	895	896
897	898	899	900	901	902	903	904
905	906	907	908	909	910	911	912
913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928
929	930	931	932	933	934	935	936
937	938	939	940	941	942	943	944
945	946	947	948	949	950	951	952
953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968
969	970	971	972	973	974	975	976
977	978	979	980	981	982	983	984
985	986	987	988	989	990	991	992
993	994	995	996	997	998	999	1000

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: AT-1C (Unless otherwise stated, all units are mg/l)

Location: 1477.1' FSL & 1660.1' FWL Sec. 7T3SR96W Elevation: 6905 Grd.

Element Measured	Depth at Which Sample Taken(ft.)			
	1	2	3	4
1. Aluminum	0.4	10	2	0.3
2. Ammonia			1.4	
3. Arsenic	<.009	.02	<.004	0.006
4. Barium	0.01	0.09	0.06	0.04
5. Beryllium	0.001	<.009	<.004	<.002
6. Bicarbonate	520	705	729	744
7. Bismuth	<.009	<.009	<.004	<.002
8. Boron	1.3	0.35	0.25	0.008
9. Cadmium	<.009	<.01	<.01	<.002
10. Calcium	67	4.0	3.6	2.4
11. Carbonate	<0.1	24	36	27
12. Cerium	<.009	0.005	0.003	0.002
13. Chloride	8	4	1	2
14. Chrome, Hexavalent	<.01	<.01	<.01	
15. Cobalt	0.004	0.004	0.01	<.002
16. Conductivity, Specific				
17. Copper	0.05	0.04	<.1	0.03
18. Fluoride	1.9	20	21	22
19. Gallium	<.009	0.006	<.004	<.002
20. Hardness, Total	350	60	40	
21. Hydroxide	<.1	<.1	<.1	
22. Iron	<.05	<.05	<.05	0.5
23. Lead	0.5	0.8	<.05	0.1
24. Lithium	.2	.4	.07	0.04
25. Magnesium	41	2.4	2.2	2.0
26. Manganese	0.26	0.07	<.05	0.01
27. Mercury	<.01	<.01	<.01	<.01
28. Molybdenum	0.02	0.03	0.01	0.009
29. Nickel	0.01	0.008	0.004	0.002
30. Nitrate	<.1	<.1	0.2	
31. pH	8.2	8.7	8.8	8.6
32. Phosphate, Total	<.1	<.1	<.1	
33. Potassium	2	1.3	0.6	0.7
34. Selenium	<.01	<.01	<.01	<.002
35. Silica	16	15	13	14
(*) 36. Silver	.009	0.014	.004	.002
37. Sodium	240	324	330	318
38. Solids, Dissolved	1020	743	765	755
39. Strontium	4	0.3	0.4	0.1
40. Sulfate	389	2.5	<2	2.5
41. Titanium	0.3	0.06	0.05	0.01
42. Vanadium	<.009	0.003	<.001	<.001
43. Yttrium	<.009	<.009	<.004	<.002
44. Zinc	0.8	0.2	3.0	0.6
45. Zirconium	<.009	<.009	<.004	<.002
46. Radioactivity				
Gross Alpha (pcl)	24	8.6	4.7	3.6
Radium 226*	0	0.7	0.2	0.1
Gross Beta (pcl)	4	0	9	14
Thorium 230**				
Uranium**				
47. Total Organic Carbon (TOC)	<.1	<.1	<.1	<.1
If TOC > 10 mg/l then measure				
Dissolved Organic Carbon				
Suspended Organic Carbon				
Phenols	<.001	<.001	<.001	
Sulfate, Acid Extraction				
Nitrogen, Base Extraction				

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

(1) 1362'-1512'

(3) 1566'-1640' (Jetting Test sample)

(2) 1515'-1640'

(4) 1566'-1640' (Drilling sample)

WATER QUALITY ANALYSIS
DRILLING WATERWell Number: SG-6 (Unless otherwise stated, all units are mg/l)Location: 2523.0' FSL & 2251.3' FWL Sec. 7 T3 SR96W Elevation: 6888

Element Measured	Depth at Which Sample Taken (ft.)				
	910	1350	1425	1547	2220
1. Aluminum		0.3	0.3	0.2	
2. Ammonia		.3	<.1	0.3	0.8
3. Arsenic	<.01	.01	.01	.03	<.01
4. Barium	<1.0	.03	.03	.08	<1
5. Beryllium		<.002	<.002	<.004	
6. Bicarbonate	360	739	751	769	760
7. Bismuth		<.002	<.002	<.004	
8. Boron	2.5	1.2	1.2	<.5	<.1
9. Cadmium	<.01	<.002	<.002	<.004	<.01
10. Calcium	25	8	5.1	4.3	7.4
11. Carbonate	30	24	25	23	48
12. Cerium		<.002	<.002	.003	
13. Chloride	19	5	2	3	13
14. Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01
15. Cobalt	<.1	.003	.003	.003	
16. Conductivity, Specific					
17. Copper	<.1	.01	.02	.03	<.1
18. Fluoride	4.2	13	19	19	4.5
19. Gallium		<.002	<.002	<.004	
20. Hardness, Total	140	60	36	30	44
21. Hydroxide		<.1	<.1	<.1	<.1
22. Iron	<.05	<.05	<.05	<.05	<.05
23. Lead	<.05	<.009	.01	<.004	<.05
24. Lithium	<1.0	.04	.3	.2	<.5
25. Magnesium	19	7.3	4.5	3.8	6.2
26. Manganese		<.05	<.05	<.05	<.05
27. Mercury	<.01	<.01	<.01	<.01	<.01
28. Molybdenum	<.05	0.05	0.02	0.03	
29. Nickel		.008	0.01	.02	
30. Nitrate	4.6	<.1	<.1	<.1	0.2
31. pH	8.8	8.5	8.5	8.6	8.3
32. Phosphate, Total	<.1	<.1	<.1	<.1	<.1
33. Potassium		1.3	1.3	1.7	
34. Selenium	<.01	<.002	<.002	<.004	<.01
35. Silica	21	13	13	13	11
(*) 36. Silver	.01	.002	.002	.004	0.012
37. Sodium	195	298	308	302	330
38. Solids, Dissolved	650	764	750	728	806
39. Strontium	0	<.002	0.3	0.3	
40. Sulfate	160	32	4	4	13
41. Titanium		0.01	0.01	.01	
42. Vanadium		<.001	<.001	<.004	
43. Yttrium		<.002	<.001	<.004	
44. Zinc	<.05	0.06	0.06	0.1	<.5
45. Zirconium		<.002	<.002	<.004	
46. Radioactivity					
Gross Alpha (pci)		5.3	4.5	5.4	
Radium 226*		0	0.1	0.2	
Gross Beta (pci)		12	6	12	
Thorium 230**					
Uranium**					
47. Total Organic Carbon (TOC)		<.1	<.1	<.1	
If TOC > 10 mg/l then measure					
Dissolved Organic Carbon					
Suspended Organic Carbon					
Phenols	.001	.001	.001	.01	.001
Sulfate, Acid Extraction					
Nitrogen, Base Extraction					

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pci).

** Required if gross beta is greater than 100 picocuries per liter (pci).

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-9 (Unless otherwise stated, all units are mg/l)
 Location: 222.2' FSL & 461' FEL, Sec. 11 T3S R97W Elevation: 6870 Grd.

Element Measured	Depth at Which Sample Taken (ft.)				
	993	1200	1285	1360	2750
1. Aluminum	5.4	7.4	0.8	0.08	0.2
2. Ammonia	0.013	0.022	0.025	0.042	
3. Arsenic	<.003	0.02	0.12	0.007	0.009
4. Barium	0.02	0.05	0.7	0.5	0.04
5. Beryllium	<.003	0.001	0.001	.006	<0.001
6. Bicarbonate	417	461	515	586	650
7. Bismuth	<.003	<.003	<.009	<.006	<.002
8. Boron	0.7	0.6	0.6	0.5	0.08
9. Cadmium	<.003	<.003	<.009	<.006	<.002
10. Calcium	6.3	4	5	5.2	7
11. Carbonate	5	0	0	0	0
12. Cerium	0.002	0.003	<.009	0.004	0.002
13. Chloride	2	2	1.4	2.3	3.2
14. Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01
15. Cobalt	0.002	0.01	0.03	0.02	0.008
16. Conductivity, Specific	620	690	820	930	
17. Copper	0.007	0.1	0.05	0.01	0.02
18. Fluoride	9	13	14	14	14
19. Gallium	0.003	<.003	<.009	<.006	<.002
20. Hardness, Total	52	30	34	38	
21. Hydroxide	<0.1	<0.1	<0.1	<0.1	
22. Iron	0.96	0.95	0.08	0.05	0.2
23. Lead	<.05	<.05	<.05	<.05	0.02
24. Lithium	.2	.5	.4	.1	0.8
25. Magnesium	4.9	4.0	3.3	4.4	4.9
26. Manganese	<.05	<.05	<.05	<.05	0.01
27. Mercury	.0001	.0001	.0001	.0001	.0028
28. Molybdenum	<.003	0.006	0.02	0.003	0.02
29. Nickel	.005	0.05	0.1	0.02	0.02
30. Nitrate	0.32	0.76	3.35	0.27	0.056
31. pH	8.5	8.2	8.2	8.0	8.2
32. Phosphate, Total	<0.1	<0.1	<0.1	<0.1	
33. Potassium	0.3	0.4	0.7	0.6	1
34. Selenium	<.003	<.003	0.05	<.006	<.002
35. Silica	16	13	14	11	11
(*) 36. Silver	<.003	<.003	<.009	<.006	<.002
37. Sodium	164	182	191	221	232
38. Solids, Dissolved	424	447	488	555	607
39. Strontium	5.0	0.3	0.4	0.6	0.4
40. Sulfate	12	3	6	8.9	15.4
41. Titanium	0.04	0.03	<.009	0.2	0.05
42. Vanadium	<.001	0.004	0.008	0.002	0.001
43. Yttrium	0.001	<.003	<.009	<.006	<.002
44. Zinc	0.02	0.3	0.4	0.03	0.02
45. Zirconium	<.003	0.003	0.01	<.006	<.002
46. Radioactivity					
Gross Alpha (pcl)	3.4	1.7	5.7	1.5	5.5
Radium 226*			0.9		0
Gross Beta (pcl)	0	0	0	0	0
Thorium 230**					
Uranium**					
47. Total Organic Carbon (TOC)	4	4	3	4	1
If TOC > 10 mg/l then measure					
Dissolved Organic Carbon					
Suspended Organic Carbon					
Phenols					
Sulfate, Acid Extraction					
Nitrogen, Base Extraction					

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

WATER QUALITY ANALYSIS
DRILLING WATERWell Number: SG-10 (Unless otherwise stated, all units are mg/l)Location: 97.0' FNL&184' FEL Sec. 13T3SR97W Elevation: 6950 Grd.

Element Measured	Depth at Which Sample Taken (ft.)			
	960	1336	1416	2211
1. Aluminum	0.9	2	2.0	19
2. Ammonia	2.1	1.8	1.9	7.0
3. Arsenic	.01	.005	<.006	.02
4. Barium	.01	.02	0.04	0.2
5. Beryllium	<.001	<.001	<.001	<.001
6. Bicarbonate	330	518	535	1212
7. Bismuth	<.001	<.001	<.001	<.001
8. Boron	4.3	1.5	<.001	<.001
9. Cadmium	<.01	.003	<.001	<.001
10. Calcium	27	8	7.6	14.8
11. Carbonate	6	6	23	28
12. Cerium	<.001	<.001	<.001	<.001
13. Chloride	3.1	0.1	1.4	103
14. Chrome, Hexavalent	<.01	<.01	<.01	<.01
15. Cobalt	.002	.04	0.04	.004
16. Conductivity, Specific				
17. Copper	0.04	.006	0.006	0.1
18. Fluoride	3.0	15	15	17
19. Gallium	<.001	.002	.001	.002
20. Hardness, Total	180	64	68	54
21. Hydroxide	<.1	<.1	<.1	<.1
22. Iron	<.05	<.05	0.6	4.
23. Lead	<.001	.003	<.001	<.001
24. Lithium	<.5	<.5	0.6	<.5
25. Magnesium	19	3.8	3.8	7.0
26. Manganese	0.05	0.05	0.01	0.2
27. Mercury	<.01	<.01	<.01	<.01
28. Molybdenum	0.02	.009	0.03	0.03
29. Nickel	.01	.01	0.05	0.03
30. Nitrate	0.32	0.56	0.74	<.1
31. pH	8.4	8.4	8.8	8.5
32. Phosphate, Total	<.1	<.1	<.1	<.1
33. Potassium	0.4	0.5	0.5	3.2
34. Selenium	.001	.02	<.004	<.004
35. Silica	21	13	11	15
(*) 36. Silver	<.01	.005	.001	<.001
37. Sodium	146	218	236	570
38. Solids, Dissolved	536	531	569	1415
39. Strontium	1	0.1	0.6	1
40. Sulfate	149	13	9	63
41. Titanium	0.3	0.1	0.04	0.5
42. Vanadium	.003	.002	.003	0.01
43. Yttrium	<.001	<.001	<.001	<.001
44. Zinc	.04	.009	0.09	.09
45. Zirconium	<.001	.001	<.001	0.01
46. Radioactivity				
Gross Alpha (pci)	2.9	9.2	1.4	5.1
Radium 226*				
Gross Beta (pci)	0	0	0	0
Thorium 230**				
Uranium**				
47. Total Organic Carbon (TOC)	0.7	0.7	31+	9
If TOC > 10 mg/l then measure				
Dissolved Organic Carbon				
Suspended Organic Carbon				
Phenols	<.05	<.003	<.003	<.001
Sulfate, Acid Extraction				
Nitrogen, Base Extraction				

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pci).

** Required if gross beta is greater than 100 picocuries per liter (pci).

+ Sample checked for benzo(a)pyrene; none found. A check of fecal coliform showed 10,000 colonies/100 ml. Sample obviously contaminated.

WATER QUALITY ANALYSIS
DRILLING WATERWell Number: SG-11 (Unless otherwise stated, all units are mg/l)Location: 12' FSL & 160' FEL Sec. 7 T3SR96W Elevation: 6900 Grd.

Element Measured	Depth at Which Sample Taken (ft.)					
	808	868	1330	1385	2465	2825
1. Aluminum	0.6	2.	2.	.6	.03	.02
2. Ammonia		0.9	<.1	0.3		.2
3. Arsenic	.03	.02	.03	.02	.01	.02
4. Barium	.04	.04	.03	.02	.2	0.06
5. Beryllium	<.001	<.01	<.009	<.001	<.002	.001
6. Bicarbonate	441	383	620	564	1036	973
7. Bismuth	<.001	<.001	<.009	<.009	<.002	<.001
8. Boron	<.1	<.1	1.0	1.6	0.4	<.1
9. Cadmium	<.001	<.01	<.009	<.009	<.002	<.001
10. Calcium	59	33	89	26	18	36
11. Carbonate	9	8	2	14	26	43
12. Cerium	<.001	<.001	<.009	<.009	.001	<.001
13. Chloride	8	6	5	3	101	68
14. Chrome, Hexavalent	<.01	<.01	<.01	<.01	<.01	<.01
15. Cobalt	.02	.02	.006	.008	.06	.03
16. Conductivity, Specific						
17. Copper	.3	.06	.01	.009	.04	.007
18. Fluoride	0.4	1.6	4.4	12	14	10
19. Gallium	.01	<.001	<.009	.008	<.001	<.001
20. Hardness, Total	350	250	580	140	67	115
21. Hydroxide	<.1	<.1	<.1	<.1	<.1	<.1
22. Iron	<.05	<.05	<.05	<.05	<.05	<.05
23. Lead	<.05	<.05	.04	<.009	0.05	.09
24. Lithium	.4	.06	.03	.1	<.5	<.001
25. Magnesium	43	33	78	18	15	28
26. Manganese	<.05	<.05	.05	<.05	<.05	<.05
27. Mercury	<.01	<.01	<.01	<.01	<.01	<.01
28. Molybdenum	0.2	<.001	.2	<.009	<.05	.01
29. Nickel	.07	.01	.01	.01	0.1	.06
30. Nitrate	1.7	3.5	<.1	<.1	<.1	<.1
31. pH	8.4	8.4	8.2	8.5	8.6	8.6
32. Phosphate, Total	<.1	<.1	<.1	<.1	<.1	<.1
33. Potassium	0.6	0.8	1.3	1.2	1.5	1.8
34. Selenium	<.001	<.001	<.009	<.009	<.002	<.001
35. Silica	24	21	19	11	17	19
(*) 36. Silver	<.001	<.001	<.009	<.009	<.002	
37. Sodium	165	141	215	211	488	500
38. Solids, Dissolved	841	634	1150	659	1244	1382
39. Strontium	7	3	1	0.5	1	1
40. Sulfate	316	202	433	86	56	199
41. Titanium	.2	.1	0.1	.04	.2	.07
42. Vanadium	.01	.003	.007	.003	<.001	<.001
43. Yttrium	<.001	<.001	.005	<.009	<.001	<.001
44. Zinc	.06	0.1	.2	.03	.08	<.3
45. Zirconium	<.001	<.001	<.009	<.009	<.003	.003
46. Radioactivity						
Gross Alpha (pcl)						
Radium 226*						
Gross Beta (pcl)						
Thorium 230**						
Uranium**						
47. Total Organic Carbon (TOC)						
If TOC > 10 mg/l then measure						
Dissolved Organic Carbon						
Suspended Organic Carbon						
Phenols	<.005	<.001	<.001	<.001	<.001	<.01
Sulfate, Acid Extraction						
Nitrogen, Base Extraction						

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

TABLE II B-12a

SG-11

ANALYSIS OF MAJOR CONSTITUENTS

AT 50 FOOT INTERVALS FROM 287' TO 1185'

Major Constituents		Depths (Ft.)																	(Unless otherwise stated, all units are mg/l)																
		287	337	387	437	487	537	587	637	687	737	787	837	885	925	975	1025	1075	1125	1185															
Calcium		120	130	130	100	98	88	125	89	67	57	34	89	29	19	9.8	25	21	23	9.8															
Magnesium		90	94	110	130	105	110	88	86	75	48	48	86	46	49	33	26	24	23	23															
Sodium		220	240	240	240	275	220	260	230	250	230	190	230	175	165	160	155	185	175	235															
Carbonate		24	24	24	23	32	30	24	48	42	30	40	48	<.1	22	24	<.1	<.1	<.1	<.1															
Bicarbonate		360	360	410	500	570	590	560	530	480	420	360	525	400	395	365	410	435	440	570															
Chloride		31	35	42	35	35	42	49	32	35	28	35	31	42	21	28	24	25	20	27															
Sulfate		690	780	770	730	650	585	610	480	450	360	240	48	225	185	100	125	120	110	95															
Nitrate		<0.1	<.1	<.1	0.1	0.1	<.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.4	5.3	11	0.4															
Phosphate		<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.01	<.1	0.4															
Silica		34	35	45	26	23	32	24	22	32	30	26	22	18	15	22	21	24	20	21															
Iron		0.16	0.14	0.05	0.10	0.05	<.05	<.05	<.05	<.05	<.05	<.05	<.05	0.16	0.18	0.32	0.05	0.11	0.25	<.05															
Fluoride		<0.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	0.6	<.1	2.8	4.6	1.2	5	6	7	9															
Hardness		670	715	770	770	685	680	670	575	475	340	280	575	260	250	160	170	150	150	120															
T.D.S.		1380	1490	1550	1620	1700	1530	1570	1290	1170	980	870	900	810	760	580	565	640	625	610															
*Conductance		1810	1870	1960	1990	1870	1840	1850	1740	1610	1340	1140	1160	1140	1050	860																			
pH		7.0	8.0	7.9	7.9	7.8	8.0	7.8	8.0	8.0	8.1	8.2	8.0	7.9	8.1	8.2	7.7	7.8	7.8	7.8															

*micromhos per c.c.

II B-199a

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-18 (a) (Unless otherwise stated, all units are mg/l)
 Location: 1240.4 FSL 365.7 FFL Sec. 25 T3S R97W Elevation: 7383 Grd.

Element Measured	Depth at Which Sample Taken (ft.)		
	960	1380	1425.6
1. Aluminum	3.2	<.05	.8
2. Ammonia	.2	.3	.3
3. Arsenic	<.01	<.01	<.01
4. Barium	0.01	0.05	0.03
5. Beryllium	<.02	<.001	<.008
6. Bicarbonate	460	496	460
7. Bismuth	<.02	<.007	<.008
8. Boron	0.4	0.6	0.4
9. Cadmium	<.01	<.01	<.01
10. Calcium	51	4	18
11. Carbonate	17	<.1	<.1
12. Cerium	<.02	0.005	<.008
13. Chloride	6.8	.7	1.4
14. Chrome, Hexavalent	<.01	<.01	<.01
15. Cobalt	<.02	<.007	0.004
16. Conductivity, Specific	710	670	750
17. Copper	<.1	<.1	<.1
18. Fluoride	9.1	10.1	9.9
19. Gallium	<.02	<.007	<.008
20. Hardness, Total	152	42	90
21. Hydroxide	<.1	<.1	<.1
22. Iron	.32	.06	.08
23. Lead	<.05	<.05	<.05
24. Lithium	<.5	.5	.5
25. Magnesium	6.1	4.0	11
26. Manganese	<.05	<.05	<.05
27. Mercury	<.01	<.01	<.01
28. Molybdenum	0.04	0.02	0.02
29. Nickel	0.01	0.006	0.008
30. Nitrate	<.1	<.1	.1
31. pH	8.3	8.0	8.0
32. Phosphate, Total	<.1	<.1	<.1
33. Potassium		0.4	
34. Selenium	<.01	<.01	<.01
35. Silica	21	13	17
(*) 36. Silver	.01	.5	.01
37. Sodium	169	167	176
38. Solids, Dissolved	557	473	501
39. Strontium	2	0.3	0.8
40. Sulfate	74	1.0	42
41. Titanium	0.2	0.1	0.1
42. Vanadium	0.004	0.004	0.003
43. Yttrium	<.02	0.003	0.003
44. Zinc	0.2	0.009	0.03
45. Zirconium	0.01	<.007	0.006
46. Radioactivity			
Gross Alpha (pcl)	0.6	1.8	4.0
Radium 226*			
Gross Beta (pcl)	0	0	0
Thorium 230**			
Uranium**			
47. Total Organic Carbon (TOC)	3	3	3
If TOC > 10 mg/l then measure			
Dissolved Organic Carbon			
Suspended Organic Carbon			
Phenols			
Sulfate, Acid Extraction			
Nitrogen, Base Extraction			

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

(a) SG-18 abandoned with fish in the hole.

WATER QUALITY ANALYSIS
DRILLING WATER

Well Number: SG-19 (Unless otherwise stated, all units are mg/l)

Location: 139.8°FNL&456.8FWL Sec. 5 T3SR96W Elevation: 6370 Grd

Element Measured	Depth at Which Sample Taken (ft.)		
	466	860	981 ⁽¹⁾
1. Aluminum	5.4	3.2	<.05
2. Ammonia	.3	.4	.7
3. Arsenic	<.01	<.01	.01
4. Barium	0.2	0.2	0.2
5. Beryllium	<.006	<.008	<.002
6. Bicarbonate	480	1160	1760
7. Bismuth	<.006	<.008	<.002
8. Boron	.4	.4	.4
9. Cadmium	<.01	<.01	<.01
10. Calcium	8.6	7.8	11
11. Carbonate	17	81	70
12. Cerium	.006	<.008	.001
13. Chloride	9.5	6.8	<.1
14. Chrome, Hexavalent	<.01	<.01	<.01
15. Cobalt	.002	.003	.005
16. Conductivity, Specific	720	1640	2350
17. Copper	<.1	<.1	<.1
18. Fluoride	9.3	10	10
19. Gallium	<.006	<.008	<.002
20. Hardness, Total	27	23	28
21. Hydroxide	<.1	<.1	<.1
22. Iron	1.06	1.0	<.5
23. Lead	<.05	<.05	<.05
24. Lithium	<.5	<.5	<.5
25. Magnesium	1.3	.9	<.1
26. Manganese	<.05	<.05	<.05
27. Mercury	<.01	<.01	<.01
28. Molybdenum	.01	.07	.009
29. Nickel	.007	.02	.01
30. Nitrate	2.3	<.1	<.1
31. pH	8.3	8.7	8.6
32. Phosphate, Total	<.1	<.1	<.1
33. Potassium	.4	.6	.9
34. Selenium	<.006	<.008	<.002
35. Silica	10	11	8.4
(*) 36. Silver	<.01	<.01	<.01
37. Sodium	220	527	762
38. Solids, Dissolved	523	1210	1720
39. Strontium	0.2	0.4	0.3
40. Sulfate	9.4	4.0	4
41. Titanium	.07	0.2	.05
42. Vanadium	.002	.003	<.001
43. Yttrium	<.006	<.008	<.002
44. Zinc	.02	<.5	.006
45. Zirconium	<.006	<.008	.003
46. Radioactivity			
Gross Alpha (pci)	2.8	0.7	0
Radium 226*			
Gross Beta (pci)	0	0	0
Thorium 230**			
Uranium**			
47. Total Organic Carbon (TOC)	4	4	3
If TOC > 10 mg/l then measure			
Dissolved Organic Carbon			
Suspended Organic Carbon			
Phenols			
Sulfate, Acid Extraction			
Nitrogen, Base Extraction			

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pci).

** Required if gross beta is greater than 100 picocuries per liter (pci).

1. Sample taken upon reaching total depth 981'.

WATER QUALITY ANALYSES

ALLUVIAL WELLS

TRACT C-b

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3765

SAMPLE MARKED: A-1

ANALYSIS:

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	80		3.992
Magnesium	80		6.584
Sodium	270	Σ Cations = 22.33	11.745
Carbonate	Less than 0.1	Σ Anions = 22.52	-----
Bicarbonate	663	% Difference = 0.4	10.873

Chloride	15		0.423
Sulfate	530		11.024
Nitrate	0.3		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	17		0.566

Iron	9.4		0.508
Fluoride	3.4		

MILLIGRAMS PER LITER

Hardness, in terms of calcium carbonate	530		
Ammonia	Less than 0.1	Manganese	0.96
Lithium	Less than 0.5	Zinc	Less than 0.5
		Silver	Less than 0.01
Barium	Less than 1.0	Mercury	Less than 0.01
Hexavalent chromium	Less than 0.01	Total dissolved solids	1,330
Arsenic	Less than 0.01	(calculated)	
Selenium	Less than 0.01		
Boron	0.6		

Hydroxide	Less than 0.1	pH	7.8
Aluminum	0.32	Specific conductance	1,790 micromhos per cc
Copper	Less than 0.1		
Cadmium	0.01		
Lead	Less than 0.05		

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II B-203

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Ochs
CHEMIST

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2600 WEST 29TH AVENUE
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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3755

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

AMPLE MARKED: A-2

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	52		2.595
Magnesium	65		5.267
Sodium	255		11.093
Carbonate	Less than 0.1	Σ Cations = 18.96	-----
Bicarbonate	586	Σ Anions = 18.79	9.610
		% Difference = 0.5	
Chloride	10		0.282
Sulfate	415		8.632
Nitrate	0.6		-----
Phosphate	1.1		-----
Silicon dioxide	22		0.733
Iron	3.5		-----
Fluoride	5.0		0.267
Hardness, in terms of calcium carbonate	395		MILLIGRAMS PER LITER
Ammonia	0.6		
Lithium	Less than 0.5	Manganese	1.5
Barium	Less than 1.0	Silver	Less than 0.01
Hexavalent chromium	Less than 0.01	Zinc	Less than 0.5
Arsenic	Less than 0.01	Mercury	Less than 0.01
Selenium	Less than 0.01	Total dissolved solids	1,110
Boron	1.7	(calculated)	
Hydroxide	Less than 0.1		
Aluminum	0.34	pH	7.4
Copper	Less than 0.1	Specific conductance	1,240 micromhos per cc
XXXXXXXXXX	XXXXXXXXXX		
Cadmium	0.12		
Lead	Less than 0.05		

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II B-204

THE INDUSTRIAL LABORATORIES COMPANY

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3767

SAMPLE MARKED: A-3 107 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	58	2.894
Magnesium	45	3.703
Sodium	250	10.875
Carbonate	Less than 0.1	
Bicarbonate	562	

Σ Cations = 17.47
 Σ Anions = 17.64
% Difference = 0.5

Chloride	7.6	-----
Sulfate	400	8.320
Nitrate	3.0	-----
Phosphate	0.3	-----
Silicon dioxide	18	0.599

Iron	Less than 0.05
Fluoride	1.9

MILLIGRAMS PER LITER

Hardness, in terms of	
calcium carbonate	330
Ammonia	Less than 0.1
Lithium	Less than 0.5

Zinc	Less than 0.5
Mercury	Less than 0.01
Lead	0.05

Total dissolved solids 1,050
(calculated)

Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	0.7
Hydroxide	Less than 0.1

pH	7.5
Specific conductance	1,480 micromhos per cc

Aluminum	0.14
Copper	Less than 0.1
Cadmium	0.016
Manganese	2.2
Silver	Less than 0.01

cc: John Matis/Frank Haas

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H. Paul Ochs
CHEMIST

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3708

SAMPLE MARKED: A-5 86

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	36	1.800
Magnesium	64	5.259
Sodium	290	12.615
Carbonate	Less than 0.1	-----
Bicarbonate	516	8.462

Σ Cations = 19.67

Σ Anions = 19.37

% Difference - 0.8

Chloride	15	0.423
Sulfate	500	10.400
Nitrate	2.2	-----
Phosphate	0.2	-----
Silicon dioxide	17	0.566

Iron	Less than 0.05
Fluoride	1.5

Hardness, in terms of
calcium carbonate

Ammonia	Less than 0.1
Lithium	Less than 0.5

Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.2

Hydroxide	Less than 0.1
Aluminum	0.06
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	0.07

MILLIGRAMS PER LITER

Manganese	2.3
Silver	0.012
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids	1,215
(calculated)	

pH 7.8

Specific conductance 1,480 micromhos
per cc

cc: Frank Haas/John Matis

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II B-206

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks

CHEMIST

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3769

SAMPLE MARKED: A-6 10/9/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium	30
Magnesium	70
Sodium	295
Carbonate	Less than 0.1
Bicarbonate	670

Chloride	17
Sulfate	405
Nitrate	3.5
Phosphate	0.3
Silicon dioxide	20

Iron	Less than 0.05
Fluoride	1.9

Hardness, in terms of
calcium carbonate

Ammonia	0.1
Lithium	Less than 0.5

Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	1.4

Hydroxide	Less than 0.1
Aluminum	Less than 0.05
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	0.066

MILLI-EQUIVALENTS

	1.497
	5.761
	12.833
Σ Cations = 20.09	-----
Σ Anions = 19.99	10.983
% Difference = 0.2	

0.479

8.424

0.666

MILLIGRAMS PER LITER

Manganese	0.12
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	1,170

pH 7.4

Specific conductance 1,540 micromhos per cc

cc: John Hatis/Frank Haas

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II B-207

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Deeks

CHEMIST

THE INDUSTRIAL LABORATORIES COMPANY

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3770

SAMPLE MARKED: A-7 10/8/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	16	0.798
Magnesium	20	1.046
Sodium	375	Σ Cations = 18.76 16.313
Carbonate	18	Σ Anions = 17.96 0.599
Bicarbonate	405	% Difference = 2.2 5.642
Chloride	11	0.310
Sulfate	475	9.988
Nitrate	4.3	-----
Phosphate	0.4	-----
Silicon dioxide	41	1.365
Iron	Less than 0.05	MILLIGRAMS PER LITER
Fluoride	8.0	
Hardness, in terms of calcium carbonate	122	Manganese 0.74
Ammonia	0.1	Silver Less than 0.01
Lithium	Less than 0.5	Zinc Less than 0.5
Barium	Less than 1.0	Mercury Less than 0.01
Hexavalent chromium	Less than 0.01	Total dissolved solids 1,100 (calculated)
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	1.4	
Hydroxide	Less than 0.1	pH 8.4
Aluminum	Less than 0.05	Specific conductance 1,180 micromhos per cc
Cadmium	Less than 0.01	
Copper	Less than 0.1	
Lead	Less than 0.05	

cc: Frank Haas/John Matis

SENT BY:

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II B-208

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Decker

CHEMIST

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/28/74

LAB. NUMBER: 3771

ATLANTIC RICHFIELD COMPANY

SAMPLE MARKED: A-5 70 Feet 10/9/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	56	2.794
Magnesium	60	4.938
Sodium	290	12.615
Carbonate	Less than 0.1	Σ Cations = 20.35
Bicarbonate	630	Σ Anions = 20.36
Chloride	3.5	% Difference = <0.1

Sulfate	480	9.984
Nitrate	3.5	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	16	0.533

Iron	Less than 0.05
Fluoride	0.8

Hardness, in terms of
calcium carbonate

Ammonia	0.1
Lithium	Less than 0.5

Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Selenium	Less than 0.01
Arsenic	Less than 0.01
Boron	0.7

Hydroxide	Less than 0.1
Aluminum	Less than 0.05
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	0.07

MILLIGRAMS PER LITER

Manganese	2.1
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01

Total dissolved solids 1,218 mg
(calculated)

pH 7.6

Specific conductance 1,400 micromhos per cc

COPIES OF: cc: John Hatis/Frank Haas

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II B-209

THE INDUSTRIAL LABORATORIES COMPANY

CHEMIST

THE INDUSTRIAL LABORATORIES COMPANY

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2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3772

SAMPLE MARKED: A-8 (No date) Small Bottles

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	74
Magnesium	75
Sodium	170
Carbonate	Less than 0.1
Bicarbonate	530

Σ Cations = 17.26

Σ Anions = 17.37

% Difference = 0.3

Chloride	4.2
Sulfate	415
Nitrate	5.1
Phosphate	Less than 0.1
Silicon dioxide	14

Iron	3.4
Fluoride	0.8
Hardness, in terms of calcium carbonate	490
Ammonia	0.1
Lithium	Less than 0.5

Barium	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01
Boron	0.6

Hydroxide	Less than 0.1
Aluminum	0.55
Copper	Less than 0.1
Cadmium	Less than 0.01
Lead	Less than 0.05

MILLIGRAMS PER LITER

Manganese	0.49
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Total dissolved solids (calculated)	607

pH 7.9
Specific conductance 1,300 micromhos
par cc

cc: Frank Haas/John Hatis

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THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Ochs

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/29/74

LAB. NUMBER: 3773

SAMPLE MARKED: A-9 57 Feet 10/9/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	49		2.445
Magnesium	57		6.502
Sodium	150		6.525
Carbonate	Less than 0.0	Σ Cations = 15.47	-----
Bicarbonate	450	Σ Anions = 15.02	7.380
		% Difference = 1.5	
Chloride	3.5		-----
Sulfate	360		7.488
Nitrate	6.6		0.106
Phosphate	Less than 0.1		-----
Silicon dioxide	14		0.466
Iron	Less than 0.05		
Fluoride	0.8		
Hardness, in terms of calcium carbonate	358		
Ammonia	0.2	Manganese	0.70
Lithium	Less than 0.5	Silver	Less than 0.01
		Zinc	Less than 0.5
		Mercury	Less than 0.01
		Total dissolved solids	861
		(calculated)	
Barium	Less than 1.0	pH	7.4
Hexavalent chromium	Less than 0.01	Specific conductance	1,000 micromhos per cc
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.7		
Hydroxide	Less than 0.1		
Aluminum	Less than 0.05		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		

cc: John Matis/Frank Haas

MEMORANDUM FOR:

AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN OF OFFICIAL BAKING CHEMISTS
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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10.29/74

LAB. NUMBER: 3774

SAMPLE MARKED: A-10 67

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	69		3.443
Magnesium	79		6.502
Sodium	150		6.950
Carbonate	Less than 0.1	Σ Cations = 16.91	-----
Bicarbonate	436	Σ Anions = 16.51	7.105
		% Difference = 1.2	
Chloride	4.8		-----
Sulfate	450		9.350
Nitrate	9.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	14		0.466
Iron	0.17		
Fluoride	0.8		
Hardness, in terms of calcium carbonate	498	Manganese	0.92
Arnonia	Less than 0.1	Silver	Less than 0.01
Lithium	Less than 0.5	Zinc	Less than 0.5
		Mercury	Less than 0.01
Barium	Less than 1.0	Total dissolved solids	1,000
Hexavalent chromium	Less than 0.01	(calculated)	
Arsenic	Less than 0.01		
Selenium	Less than 0.01	pH	8.0
		Specific conductance	1,270 microshos per cc
Boron	0.7		
Hydroxide	Less than 0.1		
Aluminum	0.25		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		

MEM. OF: CC: John Matfis/Frank Haas

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2600 WEST 29TH AVENUE
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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 10/20/74

LAB. NUMBER: 3775

SAMPLE MARKED: A-11 66 Feet 10/9/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	61	3.044
Magnesium	85	6.995
Sodium	185	8.047
Carbonate	Less than 0.1	Σ Cations = 18.09
Bicarbonate	475	Σ Anions = 17.67
		% Difference = 1.2
Chloride	4.2	-----
Sulfate	475	9.880
Nitrate	3.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	14	0.466
Iron	1.3	
Fluoride	0.5	
Hardness, in terms of calcium carbonate	502	
Ammonia	Less than 0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	0.6	
Hydroxide	Less than 0.1	
Aluminum	0.52	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	
		MILLIGRAMS PER LITER
		Manganese 0.52
		Silver Less than 0.01
		Zinc Less than 0.5
		Mercury Less than 0.01
		Total dissolved solids 1.062
		(calculated)
		pH 7.4
		Specific conductance 1,400 micromhos per cc

MEMBER OF:

AMERICAN ASSN. OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN. OF OFFICIAL LACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

II B-213

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Ochs

CHEMIST

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3776

SAMPLE MARKED: A-11 No date Small bottle

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	71	3.543
Magnesium	95	7.819
Sodium	210	9.135
Carbonate	Less than 0.1	Σ Cations = 20.50
Bicarbonate	510	Σ Anions = 19.39
		% Difference = 2.8
Chloride	4.8	-----
Sulfate	530	11.024
Nitrate	3.3	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	13	0.433
Iron	2.8	-----
Fluoride	0.5	-----
Hardness, in terms of calcium carbonate	565	MILLIGRAMS PER LITER
Ammonia	Less than 0.1	Manganese 88 0.41
Lithium	Less than 0.5	Silver Less than 0.01
		Zinc Less than 0.5
Barium	Less than 1.0	Mercury Less than 0.01
Hexavalent chromium	Less than 0.01	Total dissolved solids 1,109
Arsenic	Less than 0.01	(calculated)
Selenium	Less than 0.01	
Boron	0.7	
		pH 7.7
Hydroxide	Less than 0.1	Specific conductance 1,480 micromhos per cc
Aluminum	0.54	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

cc: John Matis/Frank Haas

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Ochs

CHEMIST

II B-214

MEMBER OF:
AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
ASSN OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3777

SAMPLE MARKED: A-12 78 Feet 10/9/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	105	5.240
Magnesium	53	4.362
Sodium	730	10.005
Carbonate	Less than 0.1	Σ Cations = 19.61
Bicarbonate	585	Σ Anions = 19.58
		✓ % Difference = <0.1
Chloride	3.5	-----
Sulfate	480	9.924
Nitrate	2.9	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	15	0.500
Iron	2.8	
Fluoride	0.7	
Hardness, in terms of calcium carbonate	473	
Ammonia	0.1	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Hexavalent chromium	Less than 0.01	
Arsenic	Less than 0.01	
Selenium	Less than 0.01	
Boron	1.2	
Hydroxide	Less than 0.1	
Aluminum	0.17	
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	
		MILLIGRAMS PER LITER
		Manganese 0.09
		Silver Less than 0.01
		Zinc Less than 0.5
		Mercury Less than 0.01
		Total dissolved solids 1,179 (calculated)
		pH 7.3
		Specific conductance 1,510 micromhos per cc

MEMORANDUM OF: cc: John Mattis/Frank Haas

AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

II B-215

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks

CHEMIST

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Sample	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
A-1	7	0.12	<0.005
A-2 @ 82'	7	0.36	0.040
A-3 @ 107'	7	0.76	<0.005
A-5 @ 86'	7	0.48	<0.005
A-6 @ 60'	7	0.70	<0.005
A-7 @ 51'	8	2.15	<0.005
A-8	4	1.02	<0.005
A-8 @ 70'	8	1.04	<0.005
A-9 @ 57'	6	1.25	<0.005
A-10 @ 67'	3	2.39	<0.005
A-11 @ 66'	3	0.99	<0.005
A-12 @ 78'	3	1.20	<0.005

II B-216



Mr. Frank Haas
12 November 74
Page 2

- * Test performed on samples marked 'Regular'
- ** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs, Ph.D.
Divisional Manager

CRW/dh

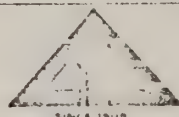
COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8494

INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-1

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.02	Titanium	1
Bismuth		Europium		Niobium		Scandium	0.01
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium	**0.0003	Neodymium		Yttrium		Potassium	*
Mercury		Praseodymium		Strontium	1	Chlorine	*
Gold		Cerium	0.02	Rubidium	0.05	Sulfur	*
Platinum		Lanthanum	0.005	Bromine	0.03	Phosphorus	1
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	≈ 12
Rhenium		Iodine	0.004	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.5	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≈ 16	Boron	0.04
Erbium		Palladium		Manganese	0.5	Beryllium	<0.001
Thulium		Rhodium		Chromium	0.02	Lithium	0.4
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported < 0.005 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-218

Approved:

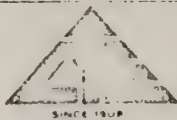
M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-2 at 82'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.005	Titanium	0.4
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.03	Samarium		Zirconium	0.005	Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.0002	Praseodymium	0.002	Strontium	2	Chlorine	*
Gold		Cerium	0.01	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.02	Phosphorus	7
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	≈30
Rhenium		Iodine		Germanium	0.003	Magnesium	*
Tungsten		Tellurium		Gallium	0.01	Sodium	*
Tantalum		Antimony		Zinc	0.05	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.05	Carbon	NR
Thulium		Silver		Iron	≈15	Boron	0.02
Erbium		Palladium		Manganese	≈7	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.02	Lithium	0.3
Yttrium						Hydrogen	NR

NR - Not Reported

All elements not reported <0.003 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-219

Approved:

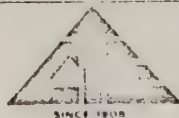
M. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-3 @ 107'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.02	Titanium	***0.7
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.006	Potassium	*
Mercury	**0.0003	Praseodymium		Strontium	2	Chlorine	*
Gold		Cerium	0.02	Rubidium	0.01	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.02	Phosphorus	2
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.004	Aluminum	≈57
Rhenium		Iodine	0.003	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.3	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.07	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	7	Boron	0.05
Erbium		Palladium		Manganese	4	Beryllium	0.001
Polmium		Rhodium		Chromium	0.02	Lithium	0.2
Dysprosium						Hydrogen	NR

II B-220

NR -- Not Reported

All elements not reported $<0.006 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

*** Heterogeneous

Approved:

W. J. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434

Reply to

INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-5 @ 86'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.03
Thorium		Gadolinium		Molybdenum	0.02	Titanium	1
Bismuth		Europium		Niobium	0.004	Scandium	0.01
Lead		Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium	0.004	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	4	Chlorine	*
Gold		Cerium	0.007	Rubidium	0.05	Sulfur	*
Platinum		Lanthanum	0.006	Bromine	0.09	Phosphorus	1
Iridium		Barium	0.6	Selenium	0.06	Silicon	*
Osmium		Cesium		Arsenic	0.05	Aluminum	≈ 30
Rhenium		Iodine	0.01	Germanium	0.03	Magnesium	*
Tungsten		Tellurium		Gallium	0.03	Sodium	*
Tantalum		Antimony		Zinc	1	Fluorine	*
Hafnium		Tin	0.02	Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.09	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver		Iron	≈ 14	Boron	0.2
Erbium		Palladium		Manganese	≈ 18	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.5
Dysprosium						Hydrogen	NR

NR — Not Reported

All elements not reported $< 0.01 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-221

Approved:

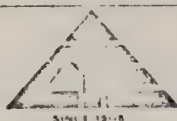
M. L. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-6 @ 60'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum		Titanium	0.08
Bismuth		Europium		Niobium		Scandium	0.005
Lead	0.1	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0017	Praseodymium	0.002	Strontium	3	Chlorine	*
Gold		Cerium	0.01	Rubidium	0.004	Sulfur	*
Platinum		Lanthanum	0.007	Bromine	0.02	Phosphorus	3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.004	Aluminum	≈26
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.09	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.02
Erbium		Palladium		Manganese	0.3	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	1
Praseodymium						Hydrogen	NR

NR -- Not Reported

II B-222

All elements not reported $<0.003 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

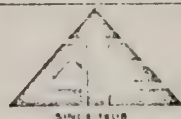
M. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-7 @ 51'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.006
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.003
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0002	Praseodymium		Strontium	2	Chlorine	*
Gold		Cerium		Rubidium	0.03	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.05	Phosphorus	1
Iridium		Barium	0.4	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	3
Rhenium		Iodine	0.002	Germanium	0.005	Magnesium	*
Tungsten		Tellurium		Gallium	0.002	Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin		Copper	0.04	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.3	Carbon	NR
Thulium		Silver		Iron	0.8	Boron	0.06
Erbium		Palladium		Manganese	***5	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	1
Praseodymium						Hydrogen	NR

NR - Not Reported

All elements not reported $<0.003\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

***Heterogeneous

II B-223

Approved:

W. J. Jacobs

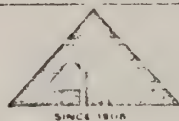
COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434

INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-8

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.03
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.3
Bismuth		Europium		Niobium	<0.001	Scandium	0.004
Lead	0.02	Samarium		Zirconium	0.004	Calcium	*
Thallium		Neodymium	0.004	Yttrium	0.004	Potassium	*
Mercury	**0.0003	Praseodymium	0.001	Strontium	0.8	Chlorine	*
Gold		Cerium	0.02	Rubidium	0.03	Sulfur	*
Platinum		Lanthanum	0.007	Bromine	0.009	Phosphorus	2
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic	0.004	Aluminum	>13
Rhenium		Iodine	0.001	Germanium	0.002	Magnesium	*
Tungsten		Tellurium		Gallium	0.001	Sodium	*
Tantalum		Antimony	0.001	Zinc	0.06	Fluorine	*
Hafnium		Tin	0.01	Copper	0.07	Oxygen	NR
Lutetium		Indium	STD	Nickel	<0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	≈ 42	Boron	0.01
Erbium		Palladium		Manganese	3	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.5
Lysprosium						Hydrogen	NR

NR — Not Reported

All elements not reported <0.001 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-224

Approved:

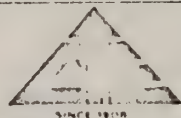
[Signature]

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-8 70'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.07	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0012	Praseodymium		Strontium	3	Chlorine	*
Gold		Cerium	0.006	Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.03	Phosphorus	0.3
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	8
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.007	Sodium	*
Tantalum		Antimony		Zinc	0.5	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.02
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.5
Ytterbium						Hydrogen	NR

NR — Not Reported

All elements not reported $< 0.008 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-225

Approved:

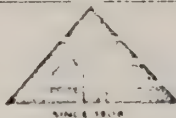
M. J. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-9 @57'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.02
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.01	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium	0.006	Yttrium	0.002	Potassium	*
Mercury	**0.0001	Praseodymium	0.001	Strontium	***2	Chlorine	*
Gold		Cerium	0.002	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.004	Bromine	0.009	Phosphorus	0.9
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.003	Aluminum	>22
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.004	Sodium	*
Tantalum		Antimony		Zinc	0.1	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.04	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≈11	Boron	0.05
Erbium		Palladium		Manganese	9	Beryllium	0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.8
Thulium						Hydrogen	NR

NR — Not Reported

All elements not reported <0.002 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

*** Heterogeneous

II B-226

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434

INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-10 @ 67'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.009
Thorium		Gadolinium		Molybdenum	***0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.01	Samarium		Zirconium	0.002	Calcium	*
Thallium		Neodymium		Yttrium	0.002	Potassium	*
Mercury	**<0.0001	Praseodymium		Strontium	0.7	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.02	Phosphorus	3
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.001	Aluminum	≈22
Rhenium		Iodine	0.001	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.05	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	4	Boron	0.02
Erbium		Palladium		Manganese	0.8	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.3
Yttrium						Hydrogen	NR

NR — Not Reported

All elements not reported <0.002 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

*** Heterogeneous

II B-227

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-11 @ 66' (Green Ink)

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.2
Thorium		Gadolinium		Molybdenum	0.2	Titanium	2
Bismuth		Europium		Niobium		Scandium	0.009
Lead	0.2	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0003	Praseodymium		Strontium	3	Chlorine	*
Gold		Cerium	0.01	Rubidium	0.06	Sulfur	*
Platinum		Lanthanum	0.01	Bromine	0.05	Phosphorus	2
Iridium		Barium	0.1	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.009	Aluminum	≈55
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.2	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	≈20	Boron	0.07
Erbium		Palladium		Manganese	2	Beryllium	
Holmium		Rhodium		Chromium	0.06	Lithium	2
Lysprosium						Hydrogen	NR

NR -- Not Reported

All elements not reported $<0.02 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-228

Approved:

M. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 80601 • AREA CODE 312 728-8434

INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: A-12 @ 78'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum		Titanium	0.4
Bismuth		Europium		Niobium		Scandium	0.02
Lead	0.07	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.007	Potassium	*
Mercury	**0.0002	Praseodymium		Strontium	3	Chlorine	*
Gold		Cerium		Rubidium	0.009	Sulfur	*
Platinum		Lanthanum		Bromine	0.05	Phosphorus	0.9
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.008	Aluminum	≈20
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.009	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.07
Erbium		Palladium		Manganese	0.7	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.06
Yttrium						Hydrogen	NR

NR — Not Reported

All elements not reported $<0.02 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

II B-229

Approved:

M. Jacobs

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

RECEIVED

DEC 2 1974

ANALYSIS REPORT OF ANALYSIS

Analysis No.	Sample Description	α		β		pCi/l		Ra^{226}	β		pCi/l		Precision*
		Total	\pm	Precision*	Total	\pm	Precision*		Total	\pm	Precision*		
7515-1	Stewart Gulch-Spring at Mouth	3.4	\pm	2.7	0	\pm	11						
-2	Middle Stewart Gulch	2.8	\pm	2.5	0	\pm	12						
-3	Savage Cabin-Stewart Gulch	4.0	\pm	2.5	0	\pm	11						
-4	East Stewart Gulch	2.1	\pm	2.2	0	\pm	12						
-5	Spring at Oland House	4.6	\pm	2.8	0	\pm	12						
-6	Willow Creek West of PL Ranch	3.3	\pm	2.6	0	\pm	12						
-7	Willow Creek 3/4 mi. past Scandard	4.7	\pm	2.8	0	\pm	12	0	\pm	0.8			
-8	Willow Creek 2 mi. past Scandard	1.3	\pm	2.1	0	\pm	12						
-9	Willow Creek Mouth-Scandard	4.2	\pm	2.8	0	\pm	12	0.3	\pm	0.5			
-10	Spring-PL Ranch	1.6	\pm	2.2	0	\pm	12						
-11✓	A-1	4.3	\pm	3.4	0	\pm	15	0.2	\pm	0.5			
-12✓	A-2 85'	2.3	\pm	3.6	0	\pm	14						
-13✓	A-3 107'	0	\pm	3.1	0	\pm	14						
-14✓	A-5 86'	0	\pm	3.0	0	\pm	14						
-15✓	A-6 60'	2.9	\pm	4.2	0	\pm	15						
-16✓	A-7 57'	14	\pm	6	6	\pm	21	0.3	\pm	0.4			
-17✓	A-8	0	\pm	2.9	9	\pm	14						
-18✓	A-8 70'	1.5	\pm	3.7	0	\pm	14						
-19✓	A-9 57'	0	\pm	2.6	0	\pm	13						
-20	9 Core Point-1200'	1.7	\pm	1.8	0	\pm	13						

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

HAZEN RESEARCH, INC.
4601 Mariana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

REPORT OF ANALYSIS

Page 2

Analysis No.	Sample Description	pCi/l		pCi/l		pCi/l		Ra ²²⁶	pCi/l		Precision*
		α	β	Total	Precision*	α	β		Total	Precision*	
7515-21	9 Bottom-1360'	1.5	0	±	2.7	15	±		±	15	
-22	Top of parachute 9 Creek-993'	3.4	0	±	2.1	13	±		±	13	
-23	Top of mining zone 9-1285'	5.7	0	±	2.7	14	±	0.9	±	14	0.6
-24 ✓	A-10 67'	2.3	0	±	2.5	14	±		±	14	
-25 ✓	A-11 66'	2.2	0	±	2.6	14	±		±	14	
-26 ✓	A-11 66'	5.0	0	±	3.2	15	±	0	±	15	0.3
-27 ✓	A-12 78'	1.6	0	±	2.4	14	±		±	14	
-28	18-Base 1425.6'	4.0	0	±	2.2	13	±		±	13	
-29	18-1380'	1.8	0	±	1.9	13	±		±	13	
-30	Top of para. 18-960'	0.6	0	±	1.7	13	±		±	13	
-31	Top of para. 19-466'	2.8	0	±	2.1	13	±		±	13	
-32	19-860'	0.7	0	±	2.6	15	±		±	15	
-33	19-TD-981'	0	0	±	3.4	33	±		±	33	

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

1jb

WATER QUALITY ANALYSES

AT - 1

TRACT C-b

Table 1

COREHOLE AT-1
MAJOR CONSTITUENTS, 952 FEET

<u>Element</u>	<u>C & L</u>	<u>TOSCO</u>	<u>Industrial Laboratories</u>
Sodium, mg/l	156	136	320
Potassium, mg/l	0.6	0.6	N.D.
Calcium, mg/l	37	32	43
Magnesium, mg/l	22	24	20
Sulfate, mg/l	215	183	210
Carbonate, mg/l	12	7	28
Bicarbonate, mg/l	372	357	670
Chloride, mg/l	0.9	0.9	33
Fluoride, mg/l	2.7	2.1	4.0
Σ Cations, meq/l	10.48	9.53	17.71
Σ Anions, meq/l	11.35	10.03	17.49
% Difference	4.0	2.6	0.6
Silica, mg/l	23	21	23
pH	8.4	8.5	8.3
Calculated TDS, mg/l	660	582	1,009

N.D. Not Determined

Table 2

COREHOLE AT-1
MINOR CONSTITUENTS, 952 FEET

<u>Element</u>	<u>Industrial Laboratories</u>	<u>C & L</u>	<u>Hazen Research</u>
Cyanide, mg/l	<0.01	<0.05	
Phosphate, mg/l	<0.1	0.05	
Lithium, mg/l	<0.5	0.04	
Phenols, mg/l	<0.001	<0.05	
Sulfide, mg/l	<0.1	0.40	
Ammonia, mg/l	1.8	0.39	
Nitrite, mg/l	<0.1	0.05	
Nitrate, mg/l	<0.1	0.21	
Total Organic Carbon, mg/l		7	
Oil and Grease		0.003	
Color		3	
Odor		2	
Gross α , pCi/l			13 \pm 3
Radium 226, pCi/l			2.3 \pm 1.4
Gross β , pCi/l			8 \pm 9

C & L LABORATORIES

Elemental Analysis - Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-074-002-03

Sample No.: TOSCO 952' depth

Agilent Test #1, Top of Parachute Creek

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.1
Bismuth		Europium		Niobium	0.0006	Scandium	0.005
Lead		Samarium		Zirconium	0.001	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	6	Chlorine	*
Gold		Cerium		Rubidium	0.03	Sulfur	*
Platinum		Lanthanum		Bromine	0.003	Phosphorus	*
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.2	Aluminum	18
Rhenium		Iodine		Germanium	0.002	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.001	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver		Iron	6	Boron	0.01
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.1	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

<0.001 ug/ml

*Reported by different methods

All elements not reported

**Source Contamination

THE INDUSTRIAL LABORATORIES COMPANY

Don - 10/10/74
15 413

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202

DATE RECEIVED: 7/7/74
DATE REPORTED: 7/12/74

LAB. NUMBER: 1231

Attn: John Matis

SAMPLE MARKED: Sorghum Gulch Top - Parachute 952'

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED IN WRITING TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium (Ca)	43
Magnesium (Mg)	20
Sodium (Na)	320
Carbonate (CO ₃)	28
Bicarbonate (HCO ₃)	670
Chloride (Cl)	33
Sulfate (SO ₄)	210
Nitrate (NO ₃)	Less than 0.1
Phosphate (PO ₄)	Less than 0.1
Silicon dioxide	23
Iron (Fe)	0.07
Fluoride (F)	4.0

MILLI-EQUIVALENTS

2.15
1.65
14.04 13.91
0.93
11.05 10.97
0.93
4.37

0.60
8.---
0.21

MILLIGRAMS PER LITER

P. alkalinity, in terms of calcium carbonate	23
NO alkalinity, in terms of calcium carbonate	570
Hardness, in terms of calcium carbonate	190
pH	8.3
Turbidity	5 units
Total dissolved solids	820
C.O.D.	21
MB-AS	Less than 0.5
Phenols	Less than 0.001
Cyanide (Cn)	Less than 0.01
Nitrite (NO ₂)	Less than 0.1
Sulfur (S)	Less than 0.1
Lithium (Li)	Less than 0.5
Barium (Ba)	Less than 1.0
Hexavalent chromium	Less than 0.01

Arsenic (As)	0.02
Selenium (Se)	Less than 0.01
Cadmium (Cd)	Less than 0.01
Copper (Cu)	Less than 0.1
Boron (B)	2.5
Manganese (Mn)	Less than 0.05
Silver (Ag)	Less than 0.01
Zinc (Zn)	Less than 0.5
Mercury (Hg)	Less than 0.01
Hydroxide	Less than 0.1
Residual chlorine	Less than 0.1
Borplium	Less than 0.1
Molybdenum	Less than 0.1
Lead (Pb)	Less than 0.05
Ammonia-nitrogen	1.8

MEMBERS OF:

AMERICAN ASSN. OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN. OF OFFICIAL LADING CHEMISTS
CANNERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Decker
CHEMIST

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WATER QUALITY ANALYSES

AT - 1a

TRACT C-b

Table 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE AT 1-1A

Element	960 Feet		1344 Feet		1424 Feet		1620 Feet	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Sodium, mg/l	220	156	290	248	300	250	300	240 246
Potassium, mg/l		0.3		0.5		0.5		0.3 0.5
Calcium, mg/l	17	11	14	10	11	11	9.8	14 10
Magnesium, mg/l	13	21	7.1	6	9.1	6	7.2	4 5
Sulfate, mg/l	185	195	65	47	52	39	37	41 24
Carbonate, mg/l	37	4	25	12	28	14	31	35 14
Bicarbonate, mg/l	320	337	600	570	610	586	620.	598 583
Chloride, mg/l	24	4	20	3	28	2.1	26	3.4 2.2
Fluoride, mg/l	1	0.9	18	14	20	15	20	14 17
Σ Cations, meq/l	11.50	9.09	13.90	11.79	14.37	11.93	14.12	11.47 11.63
Σ Anions, meq/l	11.05	9.87	13.53	11.54	13.85	11.74	13.74	12.66 11.48
% Difference	2.0	4.1	1.3	1.1	1.8	0.8	1.4	4.9 0.6
Silica, mg/l	27	24	14	13	12	13	13	11 13
pH	8.3	8.3	8.2	8.5	8.4	8.5	8.4	8.4 8.4
Calculated TDS, mg/l	681	581	747	633	759	638	748	656 617
Density at 22°C, g/ml		0.9983		0.9988		0.9984		0.9994

Table 2

MINOR CONSTITUENT ANALYSES
CORE HOLE AT 1-1A

Element	<u>960 Feet</u> <u>Industrial</u>	<u>1344 Feet</u> <u>Industrial</u>	<u>1424 Feet</u> <u>Industrial</u>	<u>1620 Feet</u> <u>Industrial</u>	<u>1620 Ft</u> <u>C&I</u>
Cyanite, mg/l	< 0.2	< 0.01	< 0.01	< 0.01	< 0.05
Phosphate, mg/l	< 0.1	0.3	< 0.1	< 0.1	0.06
Lithium, mg/l	0.6	< 0.5	< 0.5	< 0.5	0.03
Phenols, mg/l	< 0.003	< 0.001	< 0.001	< 0.001	< 0.05
BOD	1.0				
COD	9.4	19	16	17	
Sulfide, mg/l	< 0.1	< 0.1	< 0.1	< 0.1	
Ammonia, mg/l	1.9		1.6	2.2	0.8
Nitrite, mg/l	< 0.1	< 0.1	< 0.1	< 0.1	< 0.005
Nitrate, mg/l	0.46	< 0.1	< 0.1	< 0.1	0.32
Total Organic Carbon, mg/l					8
Oil and Grease					0.018
Color					7
Odor					1
Gross α pCi/l					5.9 ± 2.6
Radium 226 pCi/l					0.3 ± 0.5
Gross β pCi/l					7 ± 13

Gross α (incl. Ra 226) and gross β done by Hazen Research, Inc.



C & L LABORATORIES

Elemental Analysis -- Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

Analyst: S. Sweeney

C & L No.: 97-066-002-02

Customer No.:

Sample No.: Gulch Aquifer Test 1A 960'

CONCENTRATION IN PPM WEIGHT		CONCENTRATION IN PPM WEIGHT		CONCENTRATION IN PPM WEIGHT	
ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium	
Thorium		Gadolinium		Molybdenum	0.09
Bismuth		Europium		Niobium	0.008
Lead	0.003	Samarium		Zirconium	
Thallium		Neodymium		Yttrium	
Mercury *	0.0005	Praseodymium		Strontium	1
Gold		Cerium		Rubidium	0.008
Platinum		Lanthanum		Bromine	0.01
Iridium		Barium	0.01	Selenium	0.002
Osmium		Cesium		Arsenic	0.02
Rhenium		Iodine	0.001	Germanium	0.005
Tungsten	**	Tellurium		Gallium	0.001
Tantalum	**	Antimony		Zinc	0.03
Hafnium		Tin		Copper	0.01
Lutetium		Indium	STD	Nickel	0.02
Ytterbium		Cadmium		Cobalt	0.007
Thulium		Silver		Iron	0.2
Erbium		Palladium		Manganese	0.01
Holmium		Rhodium		Chromium	0.007
Dysprosium					
				Vanadium	0.003
				Titanium	0.01
				Scandium	0.001
				Calcium	21
				Potassium	0.4
				Chlorine	3
				Sulfur	MC
				Phosphorus	0.02
				Silicon	0.06
				Aluminum	0.1
				Magnesium	20
				Sodium	MC
				Fluorine	0.6
				Oxygen	NR
				Nitrogen	NR
				Carbon	NR
				Boron	
				Beryllium	0.00006
				Lithium	0.02
				Hydrogen	NR

NR - Not Reported

All elements not reported ~~XXXXXXXXXXXX~~

**Source Contamination

<0.001 ug/ml

*Flameless Atomic Absorption

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-074-002-03

Sample No.: TOSCO 1620' depth Aquifer Test #12, Bottom

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.07
Bismuth		Europium		Niobium	0.002	Scandium	0.0003
Lead	0.003	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	0.7	Chlorine	*
Gold		Cerium		Rubidium	0.008	Sulfur	*
Platinum		Lanthanum		Bromine	0.002	Phosphorus	*
Iridium		Barium	0.06	Selenium	0.004	Silicon	*
Osmium		Cesium	0.0009	Arsenic	0.008	Aluminum	2
Rhenium		Iodine		Germanium	0.005	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.007	Carbon	NR
Thulium		Silver		Iron	0.4	Boron	0.0002
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 µg/ml
All elements not reported XUTXXXXXXXXX
**Source Contamination

* Reported by different methods

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 6/21/74
DATE REPORTED: 6/27/74

LAB. NUMBER: 854

SAMPLE MARKED: Arco 6/20/74 Sorghum Gulch Aquifer Test 1A
960 Feet

ANALYSIS:

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

	MILLIGRAMS PER LITER		MILLIGRAMS PER LITER
Calcium	0.35 17	Lithium	0.6
Magnesium	1.32 13	Barium	Less than 1.0
Sodium	9.57 220	Hexavalent chromium	Less than 0.01
Carbonate	1.13 37	Arsenic	Less than 0.05
Bicarbonate	5.15 320	Selenium	0.011
Chloride	0.18 24	Cadmium	Less than 0.01
Sulfate	3.15 185	Copper	Less than 0.1
Nitrate	11.01 0.46	Boron	2.4
Phosphate	Less than 0.1	Manganese	Less than 0.05
Silicon dioxide	27	Silver	Less than 0.01
Iron	Less than 0.05	Zinc	Less than 0.5
Fluoride	1.0	Mercury	Less than 0.01
P. alkalinity, in terms of calcium carbonate	30	Hydroxide	Less than 0.1
MO alkalinity, in terms of calcium carbonate	260	Residual chlorine	Less than 0.1
Hardness, in terms of calcium carbonate	96	Beryllium	Less than 0.1
		Molybdenum	Less than 0.1
		Lead	Less than 0.05
Total dissolved solids	780		
Ammonia-nitrogen	1.9		
Dissolved oxygen	5.8		
5-Day B.O.D.	1.0		
C.O.D.	9.4	pH	8.3
		Turbidity	3 units
MB-AS	Less than 0.5		
Phenols	Less than 0.003		
Cyanide	Less than 0.2		
Nitrite	Less than 0.1		
Sulfide	Less than 0.1		

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THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Welch

CHEMIST

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 7/3/74

DATE REPORTED: 8/1/74

LAB. NUMBER: 1155

SAMPLE MARKED: Sorghum Gulch 1A 1,344 Feet Top

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLY-EQUIVALENTS	
Calcium	14	0.70	pH 8.2
Magnesium	7.1	0.58	Turbidity
Sodium	290	12.73	4 units
Carbonate	25	0.83	
Bicarbonate	600	9.94	
Chloride	20	0.52	
Sulfate	65	1.35	
Nitrate	Less than 0.1	----	
Phosphate	0.3	----	
Silicon dioxide	14	0.37	
Iron	Less than 0.05	----	
Fluoride	18	0.95	
P. alkalinity, in terms of calcium carbonate	20		
M alkalinity, in terms of calcium carbonate	495		
Hardness, in terms of calcium carbonate	64		
Total dissolved solids	600		
C.O.D.	19		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfur	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
		MILLIGRAMS PER LITER	
		Cadmium	Less than 0.01
		Copper	Less than 0.1
		Boron	0.6
		Manganese	Less than 0.05
		Silver	Less than 0.01
		Zinc	Less than 0.5
		Mercury	Less than 0.01
		Hydroxide	Less than 0.1
		Chlorine	Less than 0.1
		Berlyum	Less than 0.1
		Molybdenum	Less than 0.1
		Lead	Less than 0.05

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DATE REPORTED: 8/1/74

SAMPLE MARKED: Sorahum Gulch 1A - 1,424 feet Bottom

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. ESTIMABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MILLIGRAMS
PER LITER

MILLI-EQUIVALENTS

Calcium	11		0.55	pH	8.4
Magnesium	9.1		0.78		
Sodium	300		12.86	Turbidity	
Carbonate	28		0.93	1.0 units	
Bicarbonate	610		10.00		
Chloride	28		0.79		
Sulfate	52		1.08		
Nitrate	Less than 0.1		----		
Phosphate	Less than 0.1		----		
Silicon dioxide	12		0.32		
Iron	Less than 0.05		----		
Fluoride	20		1.05		
P. alkalinity, in terms of calcium carbonate	23				
NO alkalinity, in terms of calcium carbonate	500				
Hardness, in terms of calcium carbonate	64				
Total dissolved solids	640				
Ammonia-nitrogen	1.6				
C.O.D.	18				
H ₂ O-AS	Less than 0.5				
Phenols	Less than 0.001				
Cyanide	Less than 0.01				
Nitrite	Less than 0.1				
Sulfur	Less than 0.1				
Lithium	Less than 0.5				
Barium	Less than 1.0				
Hexavalent chromium	Less than 0.01				
Arsenic	Less than 0.01				
Selenium	Less than 0.01				
		Cadmium	Less than 0.01		
		Copper	Less than 0.1		
		Boron	4.1 ✓		
		Manganese	Less than 0.05		
		Silver	Less than 0.01		
		Zinc	Less than 0.5		
		Mercury	Less than 0.01		
		Hydroxide	Less than 0.1		
		Chlorine	Less than 0.1		
		Beryllium	Less than 0.1		
		Molybdenum	Less than 0.1		
		Lead	Less than 0.05		

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 7/8/74
DATE REPORTED: 8/1/74

LAB. NUMBER: 1230

SAMPLE MARKED: Sorghum Gulch Test 1A - Bottom 1,600 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	9.8	0.49	pH	8.4
Magnesium	7.2	0.59		
Sodium	300	13.07	13.04	Turbidity
Carbonate	31	1.03	1.00	2 units
Bicarbonate	620	10.22	10.16	
Chloride	26	0.73		
Sulfate	37	0.77		
Nitrate	Less than 0.1	----		
Phosphate	Less than 0.1	----		
Silicon dioxide	13	0.32		
Iron	Less than 0.05	----		
Fluoride	20	1.08		
P. alkalinity, in terms of calcium carbonate	25			
HO alkalinity, in terms of calcium carbonate	510			
Hardness, in terms of calcium carbonate	54			
Total dissolved solids	640			
Ammonia-nitrogen	2.2			
C.O.D.	17			
IB-AS	Less than 0.5			
Phenols	Less than 0.001			
Cyanide	Less than 0.01			
Nitrite	Less than 0.1			
Sulfur	Less than 0.1			
Lithium	Less than 0.5			
Barium	Less than 1.0			
Hexavalent chromium	Less than 0.01			
Arsenic	Less than 0.01			
Selenium	Less than 0.01			

MILLIGRAMS PER LITER

Cadmium	Less than 0.01
Copper	Less than 0.1
Boron	Less than 0.1
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Hydroxide	Less than 0.1
Chlorine	Less than 0.1
Beryllium	Less than 0.1
Molybdenum	Less than 0.1
Lead	Less than 0.05

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THE INDUSTRIAL LABORATORIES COMPANY

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WATER QUALITY ANALYSES

AT - 1c

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SGAT-1C, DST

Element, mg/l	1362 to 1512 feet		1515 to 1640 feet		1566 to 1640 feet (getting water)		1566 to 1640 feet (D P water)	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Sodium	260	240	300	324	310	330	318	318
Potassium	NA	2	NA	1.3	NA	0.6	0.7	0.7
Calcium	71	67	8.2	4.0	4.1	3.6	2.4	2.4
Magnesium	42	41	9.6	2.4	7.2	2.2	2.0	2.0
Sulfate	440	389	11	2.5	1.5	<2	2.5	2.5
Carbonate	<0.1	<0.1	30	24	21	36	27	27
Bicarbonate	480	520	730	705	750	729	744	744
Chloride	25	8	20	4	23	1	2	2
Fluoride	1.8	1.9	4.0	20	5.0	21	22	22
Σ Cations meq/l	18.31	17.20	14.24	14.52	14.28	14.73	14.13	14.13
Σ Anions meq/l	17.83	16.93	13.97	13.54	13.94	14.28	14.32	14.32
% Difference	1.8	0.8	1.0	3.5	1.2	1.6	0.7	0.7
Silica	22	16	11	15	11	13	14	14
pH	7.7	8.2	8.2	8.7	8.0	8.8	8.6	8.6
Calculated TDS	1,097	1,020	752	743	750	765	755	755

NA - Not Analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLO. 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74
DATE REPORTED: 8/27/74

LAB. NUMBER: 2314

SAMPLE MARKED: SG At #1C DST - 1,362 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	71	3.543	3.55
Magnesium	42	3.457	3.46
Sodium	260	11.308	11.30
Carbonate	Less than 0.1	-----	
Bicarbonate	480	7.872	7.87
Chloride	25	0.705	.70
Sulfate	440	9.152	9.17
Nitrate	Less than 0.1	-----	.09
Phosphate	Less than 0.1	-----	
Silicon dioxide	22	0.579	
Iron	Less than 0.05		
Fluoride	1.8		
P. alkalinity, in terms of calcium carbonate	Less than 0.1		
NO alkalinity, in terms of calcium carbonate	390		
Ammonia-nitrogen	0.4		
Hardness, in terms of calcium carbonate	350		
C.O.D.	11		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Hydrogen sulfide	Less than 0.1		
Nitrite	0.3		
Lithium	Less than 5		
Barium	Less than 1		
Hexavalent chromium	Less than 0.01		
		MILLIGRAMS PER LITER	
		Arsenic	Less than 0.01
		Selenium	Less than 0.01
		Boron	1.3
		Manganese	0.26
		Mercury	Less than 0.01
		Hydroxide	Less than 0.1
		Total dissolved solids	990
		pH	7.7
		Turbidity	2 units

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THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Ochs
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 8/30/74
DATE REPORTED: 9/4/74
LAB. NUMBER: 2460

SAMPLE MARKED: SG 1-C DST Jetting 1515-1640 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium
Magnesium
Sodium
Carbonate
Bicarbonate

8.2
9.6
300
30
730

0.409
0.790
12.772
0.999
11.890

$\Sigma \text{ eq. wt.} = 14.24$
 $\Sigma \text{ anion} = 13.97$
 $\% \text{ D.T.} = 1.0$

Chloride
Sulfate
Nitrate
Phosphate
Silicon dioxide

20
11
Less than 0.1
Less than 0.1
11

0.564
0.229

0.289

Iron
Fluoride
P. alkalinity, in terms
of calcium carbonate
MO alkalinity, in terms
of calcium carbonate
Hardness, in terms of
calcium carbonate

Less than 0.05
4.0

MILLIGRAMS PER LITER

C.O.D.
Phenols
Cyanide
Nitrite
Sulfide

35
Less than 0.001
Less than 0.01
Less than 0.1
Less than 0.1

Boron
Mercury
Hydroxide
Total dissolved solids
Cadmium

0.35
Less than 0.01
Less than 0.1
860
Less than 0.01

Copper
Lead
Manganese
Silver
Zinc

0.04
0.8
0.07
0.014
0.7

Lithium
Barium
Hexavalent chromium
Arsenic
Selenium

Less than 0.5
Less than 1
Less than 0.01
Less than 0.01
Less than 0.01

pH 8.2
Turbidity 12 units

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FEDERAL BUREAU OF INVESTIGATION
INSTITUTE OF FOOD TECHNOLOGY
SIOMA XI

THE INDUSTRIAL LABORATORIES COMPANY
H. Paul Vicks
CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/30/74

DATE REPORTED: 9/4/74

LAB. NUMBER: 2461

SAMPLE MARKED: SG-1-C DST 3 Jetting 1550-1640 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium 4.1
Magnesium 7.2
Sodium 310
Carbonate 21
Bicarbonate 750

Chloride 23
Sulfate 1.5
Nitrate 0.2
Phosphate Less than 0.1
Silicon dioxide 11

Iron Less than 0.05
Ammonia-nitrogen 1.4
Fluoride 5.0
P. alkalinity, in terms of calcium carbonate 17
MO alkalinity, in terms of calcium carbonate 620

Hardness, in terms of calcium carbonate 40
C.O.D. 165
Phenols Less than 0.001
Cyanide Less than 0.01
Nitrite Less than 0.1
Sulfide Less than 0.1

Lithium Less than 0.5
Barium Less than 1
Hexavalent chromium Less than 0.01
Arsenic Less than 0.01
Selenium Less than 0.01

MILLI-EQUIVALENTS

0.205 0.21
0.593 0.59
13.222 13.48
0.699 0.70
12.382 12.30
% Diff = 1.2
0.649 0.65
0.289 0.26

MILLIGRAMS PER LITER

Boron 0.25
Mercury Less than 0.01
Hydroxide Less than 0.1
Total dissolved solids 830
Cadmium Less than 0.01

Copper Less than 0.1
Lead Less than 0.05
Manganese Less than 0.05
Silver Less than 0.01
Zinc Less than 0.5

pH 8.0
Turbidity 6 units

MEMBERS OF:

AMERICAN ASSN. OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
ASSN. OF OFFICIAL AGRICULTURAL CHEMISTS
NAT'L. INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

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CHEMIST

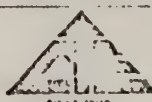
THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1362-1512 ft.

IAD No.: 97-111-002-12

μg/ml
CONCENTRATION IN ~~XXXXXXXXXX~~

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium		Scandium	
Lead	0.5	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0003	Praseodymium		Strontium	4	Chlorine	*
Gold		Cerium		Rubidium	0.005	Sulfur	*
Platinum		Lanthanum		Bromine		Phosphorus	0.2
Iridium		Barium	0.01	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	0.4
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.8	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	0.8	Boron	0.02
Erbium		Palladium		Manganese	0.1	Beryllium	0.001
Holmium		Rhodium		Chromium		Lithium	0.2
Dysprosium						Hydrogen	NR

NR — Not Reported <0.009 μg/ml
All elements not reported ~~XXXXXXXXXX~~
**Flameless Atomic Absorption

*Not reported upon request

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9321

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1515'-1640 ft.
μg/ml

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM~~ WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.06
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.4	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury ** 4.003		Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.005	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.009	Bromine	0.01	Phosphorus	0.4
Iridium		Barium	0.09	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	10
Rhenium		Iodine		Germanium	0.006	Magnesium	*
Tungsten		Tellurium		Gallium	0.006	Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	3	Boron	0.03
Erbium		Palladium		Manganese	0.2	Beryllium	
Holmium		Rhodium		Chromium	0.02	Lithium	0.4
Dysprosium						Hydrogen	NR

NR - Not Reported <0.006 μg/ml
All elements not reported ~~XXXXXXXXXXXX~~
**Flameless Atomic Absorption

*Not reported upon request
Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434
INSTRUMENTAL ANALYSIS DIVISION, 1435 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303 278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1566-1640 ft.

IAD No.: 97-111-002-12

μg/ml
CONCENTRATION IN ~~EXTRACT~~

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤0.001
Thorium		Gadolinium		Molybdenum	**0.01	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	≤0.001
Lead	0.04	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury***	0.0004	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.002	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.007	Phosphorus	0.06
Iridium		Barium	0.06	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic		Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc		Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.004	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	0.08	Boron	0.05
Erbium		Palladium		Manganese	0.03	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.07
Dysprosium						Hydrogen	NR

NR - Not Reported <0.004 μg/ml *Not Reported upon request

All elements not reported <0.1 ppm weight

**Heterogeneous

***Flameless Atomic Absorption

Approved:

M. J. Jacob

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 00001 • AREA CODE 312 720-0434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SGAT #1C D.S.T. 1566-1640 ft.

IAD No.: 97-111-002-12

CONCENTRATION IN $\mu\text{g/ml}$ DRY WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤ 0.001
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	≤ 0.001
Lead	0.1	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0007	Praseodymium		Strontium	0.1	Chlorine	*
Gold		Cerium	0.002	Rubidium	0.003	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.01	Phosphorus	0.1
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.006	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.6	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.002	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	0.5	Boron	0.008
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	0.04
Dysprosium						Hydrogen	NR

NR - Not Reported $< 0.002 \mu\text{g/ml}$

All elements not reported ~~as follows~~

**Flameless Atomic Absorption

*Not reported upon request

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

October 2, 1974

Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

ANALYTICAL REPORTMG/LITER TOC:

SG-Cb-2B Top Para Cr. 890 ft.	- .1
✓ SGAT #1C D.S.T. 1362-1512 ft.	- .1
✓ SGAT #1C D.S.T. 1515'-1640 ft.	- .1
✓ SGAT #1C D.S.T. 1566-1640 ft.	- .1
✓ SGAT #1C D.S.T. 1566-1640 ft.	- .1
SG #11 1330 ft.	- .1
SG #11 1385 ft.	- .1
SG #11 Depth 2465	- .1
SG #11 2825 ft.	- .1
SG #6 1350 ft. Top of Mining Zone	- .1
SG #6 1425 ft. Bottom of Mining Zone	- .1
SG #6 1547 ft. Below "B" Groove	- .1

Minus sign indicates parameter is below level indicated.
TOC was run on waters marked "Regular".

Sincerely,

M. L. Jacobs
M. L. Jacobs

MLJ/hb



CHICAGO, IL • CHARLESTON, WV • CLARKSBURG, WV • CLEVELAND, OH • NORFOLK, VA • TERRE HAUTE, IN • HENDERSON, KY • DENVER, CO • BIRMINGHAM, AL • VANCOUVER, B.C. CAN.

RECEIVED

OCT 15 1974

IOSCO-GOLDEN

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Date: September 27, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α		β	
		Total	\pm Precision*	Total	\pm Precision*
7371-1 ✓	S.G. A.T. #1 C Dst 1362-1512'	24	± 5	4	± 12
-2 ✓	S.G. A.T. #1 Reg. Dst 1566-1640'	4.7	± 3.1	9	± 12
-3	S.G. Cb-2B Top Para Ct. 890'	5.5	± 3.0	15	± 12
-4 ✓	S.G. A.T. 1C Dst #3 Reg. 1566-1640'	3.6	± 2.8	14	± 12
-5	S.G. #6 1350' Top of mining zone	5.3	± 3.1	12	± 12
-6	S.G. #6 Below B Groove 1547'	5.4	± 3.2	12	± 12
-7	S.G. #6 Bottom of mining zone 1425'	4.5	± 2.7	6	± 12
-8	S.G. #11 1330'	3.4	± 2.8	0	± 13
-9	S.G. 1385'	7.1	± 2.9	3	± 12
-10	S.G. #11 Depth 2465 Top G.G.	4.5	± 3.0	0	± 19
-11	S.G. #11 2825'	2.8	± 2.1	0	± 12
-12 ✓	S.G. A.T. 1C Dst-DS water 1515-1640'	9.6	± 2.8	0	± 11

By: *John C. Jarvis*
John C. Jarvis
Manager, Analytical Laboratory

1/b

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: October 14, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

REPORT OF ANALYSIS

Page 2

Analysis No.	Sample Designation	Ra ²²⁶ (pCi/l)		Precision*
		Ra	±	
7371-1 ✓	S.G. A.T. 1C DST 1362-1512 ft.	0	±	0.5
-2 ✓	S.G. A.T. 4C Reg. DST 1566-1640 ft.	0.2	±	0.7
-3	S.G. Cb-2B Top Para Ct. 890 ft.	0	±	0.5
-4 ✓	S.G. A.T. 1C DST #3 Reg. 1566-1640 ft.	0.1	±	0.6
-5	S.G. #6 1350 ft. Top of Mining Zone	0	±	0.6
-6	S.G. #6 Below "B" Groove 1547 ft.	0.2	±	0.7
-7	S.G. #6 Bottom of Mining Zone 1425 ft.	0.1	±	0.6
-8	S.G. #11 1330 ft.	0.1	±	0.6
-9	S.G. 1385 ft.	0	±	0.5
-10	S.G. #11 Depth 2465 Top G.G.	0.2	±	0.6
-11	S.G. #11 2825 ft.	0	±	0.5
-12 ✓	S.G. A.T. 1C dist. DS Water 1515-1640 ft.	0.7	±	0.7

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

WATER QUALITY ANALYSES

SG - 6

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SG-6

Element, mg/l	910 ft.		1350 ft.		1425 ft.		1547 ft.		2220 ft.	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Sodium	195	298	305	298	330	308	330	302	330	330
Potassium	NA	1.3	NA	1.3	NA	1.3	NA	1.7	NA	NA
Calcium	25	8	12	8	7.4	5.1	7.4	4.3	7.4	7.4
Magnesium	19	7.3	7.1	7.3	4.3	4.5	2.8	3.8	6.2	6.2
Sulfate	160	32	37	32	<4	4	<4	4	13	13
Carbonate	30	24	<0.1	24	45	25	33	23	48	48
Bicarbonate	360	739	760	739	740	751	750	769	760	760
Chloride	19	5	19	5	27	2	24	3	13	13
Fluoride	4.2	13	18	13	20	19	20	19	4.5	4.5
Σ Cations meq/l	11.29	14.00	14.44	14.00	15.07	14.05	14.95	13.70	15.23	15.23
Σ Anions meq/l	10.99	14.40	14.72	14.40	15.44	14.28	15.13	14.54	14.94	14.94
% Difference	1.3	1.4	1.0	1.4	1.2	0.8	0.6	2.9	1.0	1.0
Silica	21	13	14	13	13	13	16	13	11	11
pH	8.8	8.5	7.4	8.5	8.3	8.5	8.3	8.6	8.3	8.3
Calculated TDS	650	764	751	764	809	750	800	728	806	806

NA - Not Applicable

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 28TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/22/74

LAB. NUMBER: 2014

SAMPLE MARKED: S.G. #6 - Top of Parachute Creek 910 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS	
Calcium	25	1.25 1.247	
Magnesium	19	1.56 1.564	
Sodium	195	5.00 8.508	pH 8.8
Carbonate	30	1.00 0.999	
Bicarbonate	360	5.90 5.904	Turbidity Less than 1 unit
Chloride	19	0.54 0.536	
Sulfate	160	3.33 3.328	
Nitrate	4.6	0.22 -----	
Phosphate	Less than 0.1	-----	
Silicon dioxide	21	0.552	
Iron	Less than 0.05		
Fluoride	4.2		
P. alkalinity, in terms of calcium carbonate	25		
NO alkalinity, in terms of calcium carbonate	300		
Hardness, in terms of calcium carbonate	140		
Total dissolved solids	605		
MB-AS	Less than 0.5		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfur	Less than 0.1		
Lithium	Less than 1.0		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
		MILLIGRAMS PER LITER	
		Selenium	Less than 0.01
		Boron	2.5
		Mercury	Less than 0.01
		Cadmium	Less than 0.01
		Copper	Less than 0.1
		Lead	Less than 0.05
		Molybdenum	Less than 0.05
		Silver	Less than 0.01
		Zinc	Less than 0.05
		Cobalt	Less than 0.1

MEMBERS OF:

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AMERICAN CHEMICAL SOCIETY
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ASSN. OF OFFICIAL AGRICULTURAL CHEMISTS
FEDERAL BUREAU OF INVESTIGATION
INSTITUTE OF FOOD TECHNOLOGY
NORMAN XI

THE INDUSTRIAL LABORATORIES COMPANY

Paul Behr
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 8/23/74

DATE REPORTED: 8/27/74

LAB. NUMBER: 2309

SAMPLE MARKED: S.G. #6 - Top 1,350 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium (Ca)	12	0.599 0.65
Magnesium (Mg)	7.1	0.584 0.58
Sodium (Na)	305	13.245 13.24
Carbonate (CO ₃)	Less than 0.1	----
Bicarbonate (HCO ₃)	760	12.464 12.46
Chloride (Cl)	19	0.536 0.54
Sulfate (SO ₄)	37	0.770 0.77
Nitrate (NO ₃)	Less than 0.1	----
Phosphate (PO ₄)	Less than 0.1	----
Silicon dioxide (SiO ₂)	14	0.368 0.368
Iron (Fe)	Less than 0.05	0.95
Fluoride (F)	18	0.290
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
NO alkalinity, in terms of calcium carbonate	620	
Hardness, in terms of calcium carbonate	60	
C.O.D.	(27)	
MB-AS	Less than 0.5	
Phenols	Less than 0.001	
Cyanide (Cn)	Less than 0.01	
Hydrogen sulfide (H ₂ S)	Less than 0.1	
Nitrite (NO ₂)	Less than 0.1	
Lithium (Li)	Less than 5	
Barium (Ba)	Less than 1	
Hexavalent chromium	Less than 0.01	
Arsenic (As)	0.04	
		MILLIGRAMS PER LITER
		Selenium (Se) Less than 0.01
		Boron (B) 1.2
		Manganese (Mn) Less than 0.05
		Mercury (Hg) Less than 0.01
		Hydroxide (OH) Less than 0.1
		Total dissolved solids 750
		Ammonia-nitrogen 0.3
		pH 7.4
		Turbidity 1 unit

MEMBERS OF:

AMERICAN ASSOCIATION OF CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
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THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Deha
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD

DATE RECEIVED: 8/23/74

DATE REPORTED: 8/27/74

LAB. NUMBER: 2311

SAMPLE MARKED: SG #6 - Bottom 1,425 Feet

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	7.4	0.369 0.37
Magnesium	4.3	0.354 0.35
Sodium	330	14.337 14.35
Carbonate	45	1.499 1.50
Bicarbonate	740	12.136 12.13
Chloride	27	0.761 0.76
Sulfate	Less than 4	-----
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	13	0.342 0.34
Iron	Less than 0.05	-----
Fluoride	20	0.322
P. alkalinity, in terms of calcium carbonate	37	-----
NO alkalinity, in terms of calcium carbonate	610	-----
Hardness, in terms of calcium carbonate	36	-----
Ammonia-nitrogen	Less than 0.1	Arsenic 0.01
C.O.D.	7.0	Selenium Less than 0.01
MB-AS	Less than 0.5	Boron 1.2
Phenols	Less than 0.001	Manganese Less than 0.05
Cyanide	Less than 0.01	Mercury Less than 0.01
Hydrogen sulfide	Less than 0.1	Hydroxide Less than 0.1
Nitrite	Less than 0.1	Total dissolved solids 760
Lithium	Less than 5	pH 8.3
Barium	Less than 1	Turbidity 2 units
Hexavalent chromium	Less than 0.01	

MEMBERS OF:

AMERICAN ASSN. OF CHEMICAL ENGINEERS
AMERICAN CHEMICAL SOCIETY
AMERICAN SOCIETY OF CIVIL ENGINEERS
ASSN. OF PROFESSIONAL ENGINEERS
ELECTRICAL ENGINEERS
INSTITUTE OF METALLURGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Welch
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 28TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74

DATE REPORTED: 8/27/74

LAB. NUMBER: 2310

SAMPLE MARKED: SG #6 - Below "B" 1547 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	7.4	0.369 0.37
Magnesium	2.8	0.230 0.23
Sodium	330	14.220 14.35
Carbonate	33	1.099 1.10
Bicarbonate	750	12.300 12.30
Chloride	24	0.677 0.68
Sulfate	Less than 4	-----
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	16	0.421 0.42
Iron	Less than 0.05	-----
Fluoride	20	0.322
Ammonia-nitrogen	0.3	MILLIGRAMS PER LITER
P. alkalinity, in terms of calcium carbonate	27	
MO alkalinity, in terms of calcium carbonate	620	
Hardness, in terms of calcium carbonate	30	
C.O.D.	8.3	
MB-AS	Less than 0.5	
Phenols	Less than 0.01	
Cyanide	Less than 0.01	
Hydrogen sulfide	Less than 0.1	
Nitrite	0.2	
Lithium	Less than 5	
Barium	Less than 1	
Hexavalent chromium	Less than 0.01	
		Arsenic 0.02
		Selenium Less than 0.01
		Boron Less than 0.5
		Manganese Less than 0.05
		Mercury Less than 0.01
		Hydroxide Less than 0.1
		Total dissolved solids 775
		pH 8.3
		Turbidity 2 units

MEMBERS OF:

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THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Baker
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemistry

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/30/74

DATE REPORTED: 9/4/74

LAB. NUMBER: 2462

SAMPLE MARKED: SG #6 T.D. 2220 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	7.4		0.369
Magnesium	6.2		0.510
Sodium	330		14.109
Carbonate	48		1.598
Bicarbonate	760		12.464
Chloride	13		0.367
Sulfate	13		0.270
Nitrate	0.2		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	11		0.289
Iron	Less than 0.05		
Ammonia-nitrogen	0.8		
Fluoride	4.5		
P. alkalinity, in terms of calcium carbonate	39		
MO alkalinity, in terms of calcium carbonate	630		
Hardness, in terms of calcium carbonate	44		
C.O.D.	5.0		
Phenols	Less than 0.001		
Cyanide	Less than 0.01		
Nitrite	Less than 0.1		
Sulfide	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
		Selenium	Less than 0.01
		Boron	Less than 0.1
		Mercury	Less than 0.01
		Hydroxide	Less than 0.1
		Total dissolved solids	890
		Cadmium	Less than 0.01
		Copper	Less than 0.1
		Lead	Less than 0.05
		Manganese	Less than 0.05
		Silver	0.012
		Zinc	Less than 0.5
		pH	8.3
		Turbidity	Less than 1 unit

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INSTITUTE OF FOOD TECHNOLOGY
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THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Wells
CHEMIST

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COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-0434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1350 ft. Top of Mining Zone
μg/ml

IAD No.: 97-111-002-12

CONCENTRATION IN ~~PPM~~ WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.001
Thorium		Gadolinium		Molybdenum	0.05	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	
Lead	0.009	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury **	0.0009	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.007	Phosphorus	0.05
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin /		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.06	Boron	0.05
Erbium		Palladium		Manganese	0.009	Beryllium	
Holmium		Rhodium		Chromium	0.003	Lithium	0.04
Dysprosium						Hydrogen	NR

NR -- Not Reported <0.002 μg/ml

All elements not reported ~~are reported~~

**Flameless Atomic Absorption

*Not reported upon request

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1425 ft. Bottom of Mining Zone IAD No.: 97-111-002-12

CONCENTRATION IN $\mu\text{g/ml}$ ~~WET WEIGHT~~

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	≤ 0.001
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	≤ 0.001
Lead	0.01	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	≤ 0.001	Potassium	*
Mercury **	0.0008	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium		Rubidium	0.006	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.005	Phosphorus	0.04
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic	0.01	Aluminum	0.3
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.06	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.03
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.3
Dysprosium						Hydrogen	NR

NR -- Not Reported $< 0.002 \mu\text{g/ml}$ *Not reported upon request

All elements not reported satisfactorily

**Flameless Atomic Absorption

Approved:

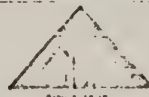
M. J. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-0434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401



Date: October 2, 1974

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #6 1547 ft. Below "B" Groove
μg/ml

IAD No.: 97-111-002-12

CONCENTRATION IN DRY WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.01
Bismuth		Europium		Niobium		Scandium	
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury ** 0.0006		Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.009	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.01	Phosphorus	0.2
Iridium		Barium	0.08	Selenium		Silicon	*
Osmium		Cesium	0.004	Arsenic	0.03	Aluminum	0.2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.1	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.04	Boron	0.04
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	0.2
Dysprosium						Hydrogen	NR

NR -- Not Reported <0.004 μg/ml
All elements not reported
**Flameless Atomic Absorption

*Not reported upon request

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-0434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

October 2, 1974

Mr. Frank Haas
TOSCO
18200 West Hiway 72
Golden, CO 80401

ANALYTICAL REPORT

MG/LITER TOC:

SG-Cb-2B Top Para Cr. 890 ft.	--.1
SGAT #1C D.S.T. 1362-1512 ft.	--.1
SGAT #1C D.S.T. 1515'-1640 ft.	--.1
SGAT #1C D.S.T. 1566-1640 ft.	--.1
SGAT #1C D.S.T. 1566-1640 ft.	--.1
SG #11 1330 ft.	--.1
SG #11 1385 ft.	--.1
SG #11 Depth 2465	--.1
SG #11 2825 ft.	--.1
✓ SG #6 1350 ft. Top of Mining Zone	--.1
✓ SG #6 1425 ft. Bottom of Mining Zone	--.1
✓ SG #6 1547 ft. Below "B" Groove	--.1

Minus sign indicates parameter is below level indicated.
TOC was run on waters marked "Regular".

Sincerely,

M. L. Jacobs
M. L. Jacobs

MLJ/hb



RECEIVED

OCT 15 1974

IOSCO-GOLDEN

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Date: September 27, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α pCi/l		β pCi/l	
		Total	\pm Precision*	Total	\pm Precision*
7371-1	S.G. A.T. #1 C Dst 1362-1512'	24	\pm 5	4	\pm 12
-2	S.G. A.T. #2 Reg. Dst 1566-1640'	4.7	\pm 3.1	9	\pm 12
-3	S.G. Cb-2B Top Para Ct. 890'	5.5	\pm 3.0	15	\pm 12
-4	S.G. A.T. 1C Dst #3 Reg. 1566-1640'	3.6	\pm 2.8	14	\pm 12
-5	S.G. #6 1350' Top of mining zone	5.3	\pm 3.1	12	\pm 12
-6	S.G. #6 Below B Groove 1547'	5.4	\pm 3.2	12	\pm 12
-7	S.G. #5 Bottom of mining zone 1425'	4.5	\pm 2.7	6	\pm 12
-8	S.G. #11 1330'	3.4	\pm 2.8	0	\pm 13
-9	S.G. 1385'	7.1	\pm 2.9	3	\pm 12
-10	S.G. #11 Depth 2465 Top G.G.	4.5	\pm 3.0	0	\pm 19
-11	S.G. #11 2825'	2.8	\pm 2.1	0	\pm 12
-12	S.G. A.T. 1C Dst-DS water 1515-1640'	8.6	\pm 2.8	0	\pm 11

By: *John C. Jarvis*

John C. Jarvis
Manager, Analytical Laboratory

ljb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96c

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
13200 West Highway 72
Golden, Colorado 80401

Date: October 14, 1974
HRI Project No. 535
HRI Series No. 7371
Samples received: Sept. 13, 1974

Page 2

REPORT OF ANALYSIS

Analysis No.	Sample Designation	Ra ²²⁶ (pCi/l)		Precision*
			±	
7371-1	S.G. A.T. 1C DST 1362-1512 ft.	0	±	0.5
-2	S.G. A.T. 2C Req. DST 1566-1640 ft.	0.2	±	0.7
-3	S.G. Cb-2B Top Para Ct. 890 ft.	0	±	0.5
-4	S.G. A.T. 1C DST #3 Reg. 1566-1640 ft.	0.1	±	0.6
✓ -5	S.G. #6 1350 ft. Top of Mining Zone	0	±	0.6
✓ -6	S.G. #6 Below "B" Groove 1547 ft.	0.2	±	0.7
✓ -7	S.G. #6 Bottom of Mining Zone 1425 ft.	0.1	±	0.6
-8	S.G. #11 1330 ft.	0.1	±	0.6
-9	S.G. 1385 ft.	0	±	0.5
-10	S.G. #11 Depth 2465 Top G.G.	0.2	±	0.6
-11	S.G. #11 2825 ft.	0	±	0.5
-12	S.G. A.T. 1C dist. DS Water 1515-1640 ft.	0.7	±	0.7

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

1/b

WATER QUALITY ANALYSES

SG - 9

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-9

Component, mg/l	993 Feet		1200 Feet		1285 Feet		1360 Feet		2750 Feet	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Na	177	164	190	182	210	191	225	221	232	232
K	NA	0.3	NA	0.4	NA	0.7	NA	0.6	1	1
Ca	9.8	6.3	7	4	6.6	5	5.7	5.2	7	7
Mg	6.7	4.9	3	4	4.3	3.3	5.8	4.4	4.9	4.9
SO ₄	22	12	<4	3	7.4	6	7.7	8.9	15.4	15.4
CO ₃	12	5	12	0	<0.1	0	<0.1	0	0	0
HCO ₃	426	417	450	461	526	515	586	586	650	650
Cl	<4	2	<4	2	2.1	1.4	1.4	2.3	3.2	3.2
F	9.8	9	10	13	10	14	10	14	14	14
Σ Cations, meq/l	8.74	7.86	8.86	8.45	9.82	8.84	10.55	10.26	10.89	10.89
Σ Anions, meq/l	8.36	7.78	8.30	8.36	9.30	9.34	10.29	10.59	11.80	11.80
% Difference	2.2	0.5	3.3	0.5	2.7	2.7	1.2	1.6	4.0	4.0
Silica, mg/l	15	16	12	13	13	14	12	11	11	11
pH	8.9	8.5	8.5	8.2	7.9	8.2	7.4	8.0	8.2	8.2
Calculated TDS, mg/l	461	424	454	447	511	488	555	555	607	607

NA - Not Analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 4795

SAMPLE MARKED: Sorghum Gulch #9 993 Feet Top of Parachute
Creek

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	9.8		0.489
Magnesium	6.7		0.581
Sodium	177		7.709
Carbonate	12	Σ Cations = 8.74	0.400
Bicarbonate	426	Σ Anions = 8.36	6.976
		% Difference = 2.2	
Chloride	Less than 4.0		-----
Sulfate	22		0.453
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	15		0.500
Iron	0.95		-----
Fluoride	9.8		0.512
P. alkalinity, in terms of calcium carbonate	000		
MO alkalinity, in terms of calcium carbonate	----		
Hardness, in terms of calcium carbonate	52	Aluminum	5.4
Total dissolved solids (calculated)	482	Copper	Less than 0.1
		Cadmium	Less than 0.01
		Lead	Less than 0.05
		Manganese	Less than 0.05
Ammonia	0.2	Silver	Less than 0.01
Lithium	Less than 0.5	Zinc	Less than 0.5
Barium	Less than 1.0	Mercury	Less than 0.01
Hexavalent chromium	Less than 0.01		
Arsenic	0.01		
Selenium	Less than 0.01	pH	8.9
Boron	0.7	Specific conductance	620 micromhos per cc
Hydroxide	Less than 0.1		

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AMERICAN OIL CHEMISTS SOCIETY
ASS'N. OF OFFICIAL ANALYTICAL CHEMISTS
BATTERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Schaefer
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 11/4/74

LAB. NUMBER: 3786

SAMPLE MARKED: Sorghum Gulch #9 1200 Feet (Cone Point)

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	7.0		0.349
Magnesium	3.0		0.247
Sodium	190		8.265
Carbonate	12	Σ Cations = 8.86	0.400
Bicarbonate	450	Σ Anions = 8.30	7.389
		% Difference = 3.3	
Chloride	Less than 4.0		-----
Sulfate	Less than 4.0		-----
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	12		0.490
Iron	0.95		-----
Fluoride	10		0.523
P. alkalinity, in terms of calcium carbonate	--		
NO alkalinity, in terms of calcium carbonate	--		
Hardness, in terms of calcium carbonate	30		
Total dissolved solids (calculated)	443		
			<u>MILLIGRAMS PER LITER</u>
		Aluminum	7.4
		Copper	Less than 0.1
		Cadmium	Less than 0.01
		Lead	Less than 0.02
		Manganese	Less than 0.05
Arsenite	0.3	Silver	Less than 0.01
Lithium	Less than 0.5	Zinc	Less than 0.5
Barium	Less than 1.0	Mercury	Less than 0.01
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.6	pH	8.5
Hydroxide	Less than 0.1	Specific conductance	690 micromhos per cc

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL AGRIC. CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Vela
CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/29/74

LAB. NUMBER: 3763

SAMPLE MARKED: Sorghum Gulch #9 (Top) 1,285 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	6.6		0.329
Magnesium	4.3		0.354
Sodium	210		9.135
Carbonate	Less than 0.1	Σ Cations = 9.82	-----
Bicarbonate	525	Σ Anions = 9.30	8.625
		% Difference = 2.7	
Chloride	2.1		-----
Sulfate	7.4		0.154
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	13		0.433
Iron	0.08		-----
Fluoride	10		0.523
Hardness, in terms of calcium carbonate	34		-----
Ammonia	0.5		MILLIGRAMS PER LITER
Lithium	Less than 0.5		
Barium	Less than 1.0	Manganese	Less than 0.05
Hexavalent chromium	Less than 0.01	Silver	Less than 0.01
Arsenic	Less than 0.01	Zinc	Less than 0.5
Selenium	Less than 0.01	Mercury	Less than 0.01
Boron	0.6	Total dissolved solids	510
Hydroxide	Less than 0.1		
Aluminum	0.8		
Copper	Less than 1.0	pH	7.9
Cadmium	Less than 0.01	Specific conductance	620 micromhos percc
Lead	Less than 0.05		

MEMBERS OF: cc: John Matts/Frank Haas

AMERICAN ASSN. OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
AMERICAN SOCIETY OF FOOD MICROBIOLOGISTS
BATTERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIOWA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks

CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 12/17/74

DATE REPORTED: 12/23/74

LAB. NUMBER: 3754

SAMPLE MARKED: Sorghum Gulch #9 (Bottom) 1,350 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	5.7	0.284
Magnesium	5.3	0.477
Sodium	225	9.739
Carbonate	Less than 0.1	-----
Bicarbonate	565	9.610
		Σ Cations = 10.55
		Σ Anions = 10.29
		% Difference = 1.2
Chloride	1.4	-----
Sulfate	7.7	0.160
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	12	0.400
Iron	0.05	-----
Fluoride	10	0.523
Hardness, in terms of calcium carbonate	30	
Ammonia	0.5	
Lithium	Less than 0.5	
		MILLIGRAMS PER LITER
MURKUM Barium	Less than 1.0	Manganese Less than 0.05
Hexavalent chromium	Less than 0.01	Silver Less than 0.01
Arsenic	Less than 0.01	Zinc Less than 0.5
Selenium	Less than 0.01	Mercury Less than 0.01
Boron	0.5	Total dissolved solids 558
Hydroxide	Less than 0.1	pH 7.4
Aluminum	0.08	Specific conductance 930 micromhos per cc
Copper	Less than 0.1	
Cadmium	Less than 0.01	
Lead	Less than 0.05	

MEMBERS OF: cc: John Hatis/Frank Haas

AMERICAN ASSN OF CLINICAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN CL. CHEMISTS SOCIETY
ASSN OF OFFICIAL BAKING CHEMISTS
BAKERY LABORERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIOMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks

CHEMIST

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COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

20 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401

Re: IAD #97-153-002-04

ANALYTICAL REPORT

	TOC* mg/liter	Nitrates** mg/liter N
Aquifer Test #1 after pumping 15 hrs.	<1	0.34
Well 1-C String #2	8	0.10
ARCO SG #18-A T.D. 1330'	<1	0.22
✓ ARCO SG-9 2750'	<1	0.056

*Test performed on samples marked "Regular" and
run by an outside laboratory.

**Test performed on samples marked "Hg for N"

Charles R. Wilson
Charles R. Wilson
Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs Ph.D.
Divisional Manager

CRW/hb

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NOV 25 1974

MOSCO-GOLDEN

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Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-270-9521

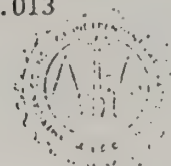
12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
ARCO SG #19 @ 860'	4	0.21	0.018
ARCO SG #19 TD @ 981'	3	0.34	0.040
✓ SG #9 Top of Mining Zone 1285'	3	3.35	0.025
SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
✓ SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
✓ ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
✓ ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013



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Mr. Frank Haas
12 November 74
Page 2

- * Test performed on samples marked 'Regular'
- ** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs, Ph.D.
Divisional Manager

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #9 @ 993' Top of
Parachute Cr.

IAD No.: 97-140-002-33

CONCENTRATION IN µg/ml

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	<0.001
Thorium		Gadolinium		Molybdenum		Titanium	0.04
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.001	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	5	Chlorine	*
Gold		Cerium	0.002	Rubidium	0.02	Sulfur	*
Platinum		Lanthanum	0.002	Bromine	0.005	Phosphorus	0.6
Iridium		Barium	0.02	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic		Aluminum	0.5
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.003	Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.007	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.4	Boron	0.002
Erbium		Palladium		Manganese	0.1	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.2
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported <0.003 µg/ml

* Not reported upon request

** Flameless Atomic Absorption

Approved:

[Handwritten signature]

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #9 Core Point @ 1200'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.006	Titanium	0.03
Bismuth		Europium		Niobium		Scandium	
Lead	0.02	Samarium		Zirconium	0.003	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.003	Rubidium	0.004	Sulfur	*
Platinum		Lanthanum	0.003	Bromine	0.02	Phosphorus	0.5
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	4
Rhenium		Iodine	0.002	Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.3	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.01	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.03
Erbium		Palladium		Manganese	0.08	Beryllium	0.001
Holmium		Rhodium		Chromium	0.005	Lithium	0.5
Dysprosium						Hydrogen	NR

NR — Not Reported

All elements not reported $< 0.003 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-0434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #9 Top of Mining Zone 1285'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.008
Thorium		Gadolinium		Molybdenum	0.02	Titanium	
Bismuth		Europium		Niobium		Scandium	0.002
Lead	0.04	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.4	Sulfur	*
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.5
Iridium		Barium	0.7	Selenium	0.05	Silicon	*
Osmium		Cesium	0.02	Arsenic	0.12	Aluminum	14
Rhenium		Iodine		Germanium	0.01	Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.4	Fluorine	*
Hafnium		Tin		Copper	0.05	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.1	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.03	Carbon	NR
Thulium		Silver		Iron	8	Boron	0.08
Erbium		Palladium		Manganese	0.3	Beryllium	0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.4
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported $< 0.009 \mu\text{g/ml}$

** Flameless Atomic Absorption

* Not reported upon request

Approved:

M. J. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #9 Btm. of Mining Zone @ 1360'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.003	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.6	Chlorine	*
Gold		Cerium	0.004	Rubidium	0.007	Sulfur	*
Platinum		Lanthanum		Bromine		Phosphorus	0.1
Iridium		Barium	0.5	Selenium		Silicon	*
Osmium		Cesium	0.003	Arsenic	0.007	Aluminum	0.6
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.1
Erbium		Palladium		Manganese	0.05	Beryllium	
Holmium		Rhodium		Chromium	0.004	Lithium	0.1
Dysprosium						Hydrogen	NR

NR -- Not Reported

All elements not reported $\leq 0.006 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

M J Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

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INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401



Date: 20 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO Sg-9 2750'

IAD No.: 97-153-002-04

$\mu\text{g/ml}$
CONCENTRATION IN ~~XXXXXX~~ WET WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.05
Bismuth		Europium		Niobium	<0.001	Scandium	0.001
Lead	0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0028	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.02	Phosphorus	0.9
Iridium		Barium	0.04	Selenium		Silicon	*
Osmium		Cesium	0.002	Arsenic	0.009	Aluminum	0.2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium	0.001	Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.008	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.08
Erbium		Palladium		Manganese	0.01	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.003	Lithium	0.8
Dysprosium						Hydrogen	NR

NR -- Not Reported < 0.002 $\mu\text{g/ml}$
All elements not reported ~~XXXXXXXXXXXX~~
*Not reported upon request
**Flameless Atomic Absorption

Approved:

M J Jacobs

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

RECEIVED

DEC 2 1974

10500-GAMMA RAY ANALYSIS

Analysis No.	Sample Description	α		β		Ra^{226}	
		Total \pm	Precision*	Total \pm	Precision*	Total \pm	Precision*
7515-1	Stewart Gulch-Spring at Mouth	3.4 \pm	2.7	0			
-2	Middle Stewart Gulch	2.8 \pm	2.5	0			
-3	Savage Cabin-Stewart Gulch	4.0 \pm	2.5	0			
-4	East Stewart Gulch	2.1 \pm	2.2	0			
-5	Spring at Oland House	4.6 \pm	2.8	0			
-6	Willow Creek West of PL Ranch	3.3 \pm	2.6	0			
-7	Willow Creek 3/4 mi. past Scandard	4.7 \pm	2.8	0		0 \pm	0.8
-8	Willow Creek 2 mi. past Scandard	1.3 \pm	2.1	0			
-9	Willow Creek Mouth-Scandard	4.2 \pm	2.8	0		0.3 \pm	0.5
-10	Spring-PL Ranch	1.6 \pm	2.2	0			
-11	A-1	4.3 \pm	3.4	0		0.2 \pm	0.5
-12	A-2 85'	2.3 \pm	3.6	0			
-13	A-3 107'	0 \pm	3.1	0			
-14	A-5 86'	0 \pm	3.0	0			
-15	A-6 60'	2.9 \pm	4.2	0			
-16	A-7 57'	14 \pm	6	6		0.3 \pm	0.4
-17	A-8	0 \pm	2.9	9			
-18	A-8 70'	1.5 \pm	3.7	0			
-19	A-9 57'	0 \pm	2.6	0			
-20	9 Core Point-1200'	1.7 \pm	1.8	0			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

REPORT OF ANALYSIS

Page 2

Analysis No.	Sample Description	α		β		pCi/l		Ra^{226}	pCi/l	
		Total	\pm	Precision*	Total	\pm	Precision*		Total	\pm
7515-21 ✓	9 Bottom-1360'	1.5	\pm	2.7	0	\pm	15			
-22 ✓	Top of parachute 9 Creek-993'	3.4	\pm	2.1	0	\pm	13			
-23 ✓	Top of mining zone 9-1285'	5.7	\pm	2.7	0	\pm	14	0.9	\pm	0.6
-24	A-10 67'	2.3	\pm	2.5	0	\pm	14			
-25	A-11 56'	2.2	\pm	2.6	0	\pm	14			
-26	A-11 66'	5.0	\pm	3.2	0	\pm	15	0	\pm	0.3
-27	A-12 78'	1.6	\pm	2.4	0	\pm	14			
-28	18-Base 1425.6'	4.0	\pm	2.2	0	\pm	13			
-29	18-1380'	1.8	\pm	1.9	0	\pm	13			
-30	Top of para. 18-960'	0.6	\pm	1.7	0	\pm	13			
-31	Top of para. 19-466'	2.8	\pm	2.1	0	\pm	13			
-32	19-860'	0.7	\pm	2.6	0	\pm	15			
-33	19-TD-981'	0	\pm	3.4	0	\pm	33			

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

1jb

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. F. C. Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: December 3, 1974
HRI Project No. 535
HRI Series No. 7559
Samples received: November 1, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α pCi/l		β pCi/l		β Precision*		Ra^{226} pCi/l		β Precision*	
		Total	\pm	Total	\pm	Total	\pm	Total	\pm	Total	\pm
7559-1	Aquifer Test #1 Pumped 15 hrs.	4.2	\pm	2.3	\pm	0	\pm	0.3	\pm	11	\pm
-2	Well #1-C String #2	0.6	\pm	3.4	\pm	9	\pm		\pm	12	\pm
-3 ✓	SG-9 2750'	5.5	\pm	2.6	\pm	0	\pm	0	\pm	11	\pm
-4	SG-18-ATD 1380	8.0	\pm	3.3	\pm	0	\pm	0.1	\pm	11	\pm

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ujb

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

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DEC 4 1974

OSCO-GOLDEN

WATER QUALITY ANALYSES

SG - 10

TRACT C-b

TABLE 1
MAJOR CONSTITUENT ANALYSES

CORE HOLE NO. SG-10

Element	960 Feet			1336 Feet			1416 Feet			2211 Feet		
	Ind.	C&L	TOSCO	Ind.	C&L	TOSCO	Ind.	C&L	TOSCO	Ind.	TOSCO	
Sodium, mg/l	160	140	146	180	190	218	230	215	236	440	570	
Potassium, mg/l	ND	0.4	0.4	ND	0.65	0.5	ND	0.5	0.5	ND	3.2	
Calcium, mg/l	29	46	27	9.8	14	8	6.6	13	7.6	16	14.8	
Magnesium, mg/l	26	18	19	9.6	4.0	3.8	13	4	3.8	3.7	7.0	
Sulfate, mg/l	170	150	149	21	25	13	27	24	9	55	63	
Carbonate, mg/l	37	13	6	31	16	6	37	17	23	34	28	
Bicarbonate, mg/l	320	332	330	510	502	518	573	547	535	830	1212	
Chloride, mg/l	18	4.4	3.1	15	0.5	0.1	14	3.0	1.4	120	103	
Fluoride, mg/l	3.5	3.3	3.0	8.0	14	15	18	14	15	16	17	
Σ Cations, meq/l	10.58	9.90	9.24	9.12	9.31	10.21	11.41	10.34	10.97	20.24	26.18	
Σ Anions, meq/l	10.71	9.29	8.96	10.67	10.05	9.74	12.48	10.84	10.53	20.10	26.76	
% Difference	0.6	3.2	1.5	7.8	3.8	2.4	4.5	2.4	2.0	0.3	1.1	
Silica, mg/l	24	34	21	13	11	13	13	11	11	15	15	
pH	8.4	8.3	8.4	8.5	8.4	8.4	8.5	8.3	8.8	8.2	8.5	
Calculated TDS, mg/l	624	572	536	537	522	531	639	570	569	1106	1415	
Density @ 22°C, g/ml			0.9986			0.9984			0.9985		0.9983	

TABLE 2.
MINOR CONSTITUENTS
CORE HOLE NO. SG-10

Element	960 Feet		1336 Feet		1416 Feet		2211 Feet	
	Ind.	C&L	Ind.	C&L	Ind.	C&L	Ind.	C&L
Cyanide, mg/l	< 0.2	< 0.05	< 0.2	< 0.05	< 0.2	< 0.05	< 0.01	0.10
Phosphate, mg/l	< 0.1	0.02	< 0.1	< 0.01	< 0.1	< 0.01	< 0.1	< 0.01
Lithium, mg/l	< 0.5	< 0.05	< 0.5	< 0.05	0.6	< 0.05	< 0.5	0.84
Phenols, mg/l	< 0.05	< 0.05	< 0.003	< 0.05	< 0.003	< 0.05	< 0.001	< 0.05
BOD	0.3	12.5	0.4	12.5	0.9	12.5	ND	ND
COD	14	2.9	< 0.5	< 0.4	4.7	18	11	ND
Sulfide, mg/l	< 0.1	0.03	< 0.1	0.06	< 0.1	0.06	< 0.1	< 0.03
Ammonia, mg/l	2.1	0.27	1.8	0.77	1.9	0.65	7.0	2.9
Nitrite, mg/l	< 0.005			< 0.005		< 0.005	ND	ND
Nitrate, mg/l	0.32	0.22	0.56	0.26	0.74	0.32		ND
Total Organic Carbon, mg/l	ND	0.7	ND	0.7	ND	31	ND	9
Oil and Grease	ND	0.001	ND	0.023	ND	0.027	ND	0.007
Color	ND	2	ND	6	ND	10	ND	9
Odor	ND	0	ND	0	ND	4	ND	0
*Gross α , p Ci/l	2.9 ⁺ 1.9		9.2 ⁺ 2.7		1.4 ⁺ 1.4		5.1 ⁺ 3.5	
Radium 226, p Ci/l			0 ⁺ 0.4				0 ⁺ 1.9	
*Gross β , p Ci/l	0 ⁺ 10		0 ⁺ 12		0 ⁺ 11		0 ⁺ 20	

*Gross α (including Ra 226) and β done by Hazen Research, Inc.

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 1416' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.04
Bismuth		Europium		Niobium	0.0006	Scandium	0.01
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	0.6	Chlorine	*
Gold		Cerium		Rubidium	0.003	Sulfur	*
Platinum		Lanthanum		Bromine	0.002	Phosphorus	*
Iridium		Barium	0.04	Selenium	0.004	Silicon	*
Osmium		Cesium	0.0009	Arsenic	0.006	Aluminum	2
Rhenium		Iodine		Germanium	0.001	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.001	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.006	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.05	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.04	Carbon	NR
Thulium		Silver	0.001	Iron	0.6 <	Boron	
Erbium		Palladium		Manganese	0.01	Beryllium	
Holmium		Rhodium		Chromium	0.04	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

<0.001 µg/ml

All elements not reported

*Reported by different methods

**Source Contamination

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-074-002-03

Sample No.: TOSCO 2211' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium	0.002	Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.5
Bismuth		Europium	0.002	Niobium	0.0006	Scandium	0.003
Lead		Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium	0.0003	Potassium	*
Mercury	*	Praseodymium	0.0009	Strontium	1	Chlorine	*
Gold		Cerium		Rubidium	0.08	Sulfur	*
Platinum		Lanthanum		Bromine	0.1	Phosphorus	*
Iridium		Barium	0.2	Selenium	0.004	Silicon	*
Osmium		Cesium	0.01	Arsenic	0.02	Aluminum	19
Rhenium		Iodine	0.01	Germanium	0.01	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony		Zinc	0.09	Fluorine	*
Hafnium		Tin		Copper	0.1	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.03	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	4	Boron	
Erbium		Palladium		Manganese	0.2	Beryllium	0.00006
Holmium		Rhodium		Chromium	0.04	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported

<0.001 ug/ml

All elements not reported XXXXXXXXXXXXXXX

**Source Contamination

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

*Reported by different methods

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 6/19/74

DATE REPORTED: 6/27/74

LAB. NUMBER: 787

960
SAMPLE MARKED: SG #10 360 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. ESTIMABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS. PER LITER		MILLIGRAMS PER LITER
Calcium	1.45 29	Barium	Less than 1.0
Magnesium	2.17 26	Hexavalent chromium	Less than 0.01
Sodium	6.94 160	Arsenic	Less than 0.05
Carbonate	1.23 37	Selenium	0.012
Bicarbonate	5.25 320	Cadmium	Less than 0.01
Chloride	0.51 18		
	3.54	Copper	Less than 0.1
Sulfate	10.53 170	Boron	4.3
Nitrate	0.32	Lead	Less than 0.05
Phosphate	Less than 0.1	Manganese	0.05
Silicon dioxide	24	Silver	Less than 0.01
Iron	Less than 0.05		
Fluoride	3.5	Zinc	Less than 0.5
P. alkalinity, in terms of calcium carbonate	30	Mercury	Less than 0.01
NO alkalinity, in terms of calcium carbonate	260	Hydroxide	Less than 0.1
Hardness, in terms of calcium carbonate	180 260	Residual chlorine	Less than 0.1
Total dissolved solids	500 624	Beryllium	Less than 0.1
		Molybdenum	Less than 0.1
Dissolved oxygen	5.2		
C.O.D.	14	pH	8.4
5-Day B.O.D.	0.3	Turbidity	3 units
MD-AS	Less than 0.5		
Phenols	Less than 0.05		
Ammonia-nitrogen	2.1		
Cyanide	Less than 0.2		
Nitrite	Less than 0.1		
Sulfide	Less than 0.1		
Lithium	Less than 0.5		

MEMBERS OF:

AMERICAN ASSOCIATION OF CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN SOCIETY OF CLIMATE ENGINEERS
AMERICAN SOCIETY OF DISTRICT ENGINEERS
AMERICAN SOCIETY OF ELECTRICAL ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF PETROLEUM ENGINEERS
AMERICAN SOCIETY OF THERMAL ENGINEERS
AMERICAN SOCIETY OF WATERS ENGINEERS
AMERICAN SOCIETY OF WATERS ENGINEERS

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks

CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 6/19/74

DATE REPORTED: 6/27/74

LAB. NUMBER: 788

SAMPLE MARKED: SG 10 1,336 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLIGRAMS PER LITER
Calcium	0.44 9.8	Hexavalent chromium	Less than 0.01
Magnesium	0.80 9.6	Arsenic	Less than 0.05
Sodium	7.83 180	Selenium	Less than 0.01
Carbonate	1.03 31	Cadmium	Less than 0.01
Bicarbonate	2.36 510	Copper	Less than 0.1
Chloride	0.42 15	Boron	1.5
Sulfate	0.44 21	Lead	Less than 0.05
Nitrate	10.25 0.56	Manganese	Less than 0.05
Phosphate	Less than 0.1	Silver	Less than 0.01
Silicon dioxide	13	Zinc	Less than 0.5
Fluoride	8.0	Mercury	Less than 0.01
Iron	Less than 0.05	Hydroxide	Less than 0.1
P. alkalinity, in terms of calcium carbonate	25	Residual chlorine	Less than 0.1
MO alkalinity, in terms of calcium carbonate	420	Beryllium	Less than 0.1
Hardness, in terms of calcium carbonate	64 Calc.	Molybdenum	Less than 0.1
Total dissolved solids	650 537		
Ammonia nitrogen	1.8	pH	8.5
Dissolved oxygen	3.8	Turbidity	3 units
5-Day B.O.D.	0.4		
C.O.D.	Less than 0.5		
Phenols	Less than 0.003		
Cyanide	Less than 0.2		
Nitrite	Less than 0.1		
Sulfide	Less than 0.1		
Lithium	Less than 0.5		
Barium	Less than 1.0		

ANALYSIS ON:

AMERICAN ASSOCIATION OF CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN SOCIETY OF CLIMATE ENGINEERS
AMERICAN SOCIETY OF FOOD ENGINEERS
AMERICAN SOCIETY OF MECHANICAL ENGINEERS
AMERICAN SOCIETY OF PETROLEUM ENGINEERS
AMERICAN SOCIETY OF THERMAL ENGINEERS
AMERICAN SOCIETY OF WATERS ENGINEERS
AMERICAN SOCIETY OF WATERS ENGINEERS
AMERICAN SOCIETY OF WATERS ENGINEERS

THE INDUSTRIAL LABORATORIES COMPANY

J. Paul DeLoe
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 24TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

DATE RECEIVED: 6/19/74

DATE REPORTED: 6/27/74

Attn: John Matis

LAB. NUMBER: 789

SAMPLE MARKED: SG 10 1,416 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLIGRAMS PER LITER
Calcium (Ca)	0.33 6.6	Lithium (Li)	0.6
Magnesium (Mg)	1.01 13	Barium (Ba)	Less than 1.0
Sodium (Na)	10.00 230	Hexavalent chromium	Less than 0.01
Carbonate (CO ₃)	1.23 37	Arsenic (As)	Less than 0.05
Bicarbonate (HCO ₃)	9.39 573	Selenium (Se)	Less than 0.01
Chloride (Cl)	0.39 14	Cadmium (Cd)	Less than 0.01
Sulfate (SO ₄)	0.56 27	Copper (Cu)	Less than 0.1
Nitrate (NO ₃)	11.51 0.74	Boron (B)	2.7
Phosphate (PO ₄)	Less than 0.1	Manganese (Mn)	Less than 0.05
Silicon dioxide (SiO ₂)	13	Silver (Ag)	Less than 0.01
Iron (Fe)	Less than 0.05	Zinc (Zn)	Less than 0.5
Fluoride (F)	18	Mercury (Hg)	Less than 0.01
P. alkalinity, in terms of calcium carbonate	30	Hydroxide (OH)	Less than 0.1
NO alkalinity, in terms of calcium carbonate	470	Residual chlorine	Less than 0.1
Hardness, in terms of calcium carbonate	68	Beryllium (Be)	Less than 0.1
Total dissolved solids	540	Molybdenum (Mo)	Less than 0.1
Ammonia-nitrogen	1.8		
Dissolved oxygen	3.4		
5-Day B.O.D.	0.9	pH	8.5
C.O.D.	4.7		
HB-AS	Less than 0.5		
Phenols	Less than 0.003		
Cyanide (Cn)	Less than 0.2		
Nitrite (NO ₂)	Less than 0.1		
Sulfide	Less than 0.1		

MEMBERS OF:

AMERICAN ASSOCIATION OF CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN SOCIETY OF CLIMATE ENGINEERS
AMERICAN SOCIETY OF FOOD TECHNOLOGISTS
AMERICAN SOCIETY OF FOOD TECHNOLOGISTS
AMERICAN SOCIETY OF FOOD TECHNOLOGISTS
AMERICAN SOCIETY OF FOOD TECHNOLOGISTS

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Beale
CHEMIST

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TELEPHONE 455-3641

LAB. NUMBER: 1232

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PREFERABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

MILLI-EQUIVALENTS

ANALYSIS OF WATER		ANALYSIS OF WATER	
Calcium	16	1.80	pH 8.2
Magnesium	3.7	1.10	0.31
Sodium	440	19.09	19.13
Carbonate	34	1.13	Turbidity 6 units
Bicarbonate	830	13.66	13.61
Chloride	120	3.38	
Sulfate	55	1.14	
Nitrate	Less than 0.1	----	
Silicon dioxide	15	0.39	
Phosphate	Less than 0.1	----	
Iron	Less than 0.05	----	
Fluoride	16	1.10	0.84
P. alkalinity, in terms of calcium carbonate	28	<u>MILLIGRAMS PER LITER</u>	
NO ₃ alkalinity, in terms of calcium carbonate	680	Selenium	Less than 0.01
Hardness, in terms of calcium carbonate	54	Cadmium	Less than 0.01
		Copper	Less than 0.1
		Boron	5.0
Total dissolved solids	880	Manganese	Less than 0.05
Ammonia-nitrogen	7.0		
C.O.D.	11	Silver	Less than 0.01
MB-AS	Less than 0.5	Zinc	Less than 0.5
Phenols	Less than 0.001	Mercury	Less than 0.01
		Hydroxide	Less than 0.1
Cyanide	Less than 0.01	Chlorine	Less than 0.1
Nitrite	Less than 0.1		
Sulfur	Less than 0.1	Beryllium	Less than 0.1
Lithium	Less than 0.5	Molybdenum	Less than 0.1
Barium	Less than 1.0	Lead	Less than 0.05
Hexavalent chromium	Less than 0.01		
Arsenic	Less than 0.01		

AMERICAN ASSN OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASSN OF CEREAL PACKING CMISTS
BARRY L. HORN, DR. OF AGRICULTURE
INSTITUTE OF FOOD TECHNOLOGY
SIOMA XI

H. Paul Olsen
CHEMIST

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C & L LABORATORIES

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(303) 278-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 960' depth SG #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.3
Bismuth		Europium		Niobium	0.003	Scandium	0.002
Lead		Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	*	Praseodymium		Strontium	1	Chlorine	*
Gold		Cerium		Rubidium	0.006	Sulfur	*
Platinum		Lanthanum		Bromine	0.003	Phosphorus	*
Iridium		Barium	0.01	Selenium	0.001	Silicon	*
Osmium		Cesium	0.0004	Arsenic	0.01	Aluminum	0.9
Rhenium		Iodine		Germanium	0.002	Magnesium	*
Tungsten	**	Tellurium		Gallium		Sodium	*
Tantalum	**	Antimony	0.0007	Zinc	0.04	Fluorine	*
Hafnium		Tin		Copper	0.04	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.9	Boron	
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.007	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 ug/ml
All elements not reported ~~XXXXXXXXXXXX~~
**Source Contamination

* Reported by different methods

C & L LABORATORIES

Elemental Analysis -- Mass Spectrometry

General Analytical Services

To: Mr. Frank Haas
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18200 West Hiway 72
Golden, CO 80401

Date: 8-5-74

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-057-002-11

Sample No.: TOSCO 1336' depth SC #10

CONCENTRATION IN PPM WEIGHT

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium	0.001	Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.1
Bismuth		Europium		Niobium	0.002	Scandium	0.0005
Lead	0.003	Samarium		Zirconium	0.001	Calcium	*
Thallium		Neodymium		Yttrium	0.0006	Potassium	*
Mercury	*	Praseodymium		Strontium	0.1	Chlorine	*
Gold		Cerium	0.001	Rubidium	0.008	Sulfur	*
Platinum		Lanthanum	0.0009	Bromine	0.01	Phosphorus	*
Iridium		Barium	0.02	Selenium	0.02	Silicon	*
Osmium		Cesium	0.003	Arsenic	0.005	Aluminum	2
Rhenium		Iodine	0.0009	Germanium	0.005	Magnesium	*
Tungsten	**	Tellurium		Gallium	0.002	Sodium	*
Tantalum	**	Antimony	0.005	Zinc	0.009	Fluorine	*
Hafnium		Tin		Copper	0.006	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium	0.003	Cobalt	0.04	Carbon	NR
Thulium		Silver	0.005	Iron	0.2	Boron	
Erbium		Palladium		Manganese	0.004	Beryllium	
Holmium		Rhodium		Chromium	0.001	Lithium	*
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 ug/ml
All elements not reported

**Source Contamination

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

*Reported by different methods

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

August 8, 1974

Mr. Frank Haas
The Oil Shale Corp.
18200 W. Hiway 72
Golden, CO 80401

Dear Mr. Haas:

These are corrected results from analysis of water samples
a) Arco 6-17-74 SG #10 960' b) Arco 6-17-74 SG #10 1336', and c)
Arco 6-17-74 SG #10 1416', assigned C & L #97-057-002-11.

Footage	mg/L	
	SO ₄	Bicarbonate Alkalinity as CaCO ₃
960	150	550
1336	25	840
1416	24	910

If you have any further questions regarding the analysis or procedures,
please don't hesitate to call.

S. Sweeney
S. Sweeney, Analyst

jj

C & L LABORATORIES

Elemental Analysis — Mass Spectrometry

General Analytical Services

14335 West 44th Ave
Golden, Colo. 80401
(303) 278-9521

July 17, 1974

Mr. Frank Haas
The Oil Shale Corp.
18200 W. Hiway 72
Golden, CO 80401ANALYTICAL REPORT

Partial analysis, of water samples a) Arco 6-17-74 SG #10 960', b) Arco 6-17-74 SG #10 1336' and c) Arco 6-17-74 SG #10 1416', received June 19, 1974, and assigned C & L #97-057-002-11. Samples are referred to by their footage numbers. Each sample received was in six portions, one untreated marked regular, and the remaining five were pretreated by you and labeled BOD, Hg for N, CN + NaOH, Phenol + CU - Acid, and Metal & Acid. All tests were run on the untreated (Regular) sample unless otherwise stated.

ANALYSIS

Footage	µg/ml						
	Na	Ca	K	Mg	Li	Si	F
960	140	46	0.39	18	<0.05	16	3.3
1336	190	14	0.65	4.0	<0.05	5.0	14
1416	215	13	0.47	4.0	<0.05	5.0	14

Footage	pCi/L	
	α*	β*
960	2.9 ± 1.9	0 ± 10
1336	9.2 ± 2.7	0 ± 12
1416	1.4 ± 1.4	0 ± 11

Footage	mg/L			
	COD	TOC*	Cl	SO ₄
960	2.9	0.7	4.4	0.15
1336	<0.4	0.7	3.0	0.03
1416	18	31	0.5	0.02

* Outside Lab

Footage	mg/L	
	Carbonate Alkalinity as CaCO_3	Bicarbonate Alkalinity as CaCO_3
960	21	1140
1336	28	1710
1416	28	1870

Footage	g/L		
	Dissolved Solids	Suspended Solids	Oil & Grease**
960	0.46	0.09	0.001
1336	0.45	0.07	0.023
1416	0.44	0.11	0.027

**Sample should have been collected in a glass bottle, at least one liter in volume, and preserved with 2 ml H_2SO_4 /liter.

Five Day BOD Analysis - Performed on sample portion marked BOD

Footage	mg/L
960	12.5
1336	12.5
1416	12.5

CN Analysis - Performed on sample portion marked CN + NaOH

Footage	$\mu\text{g/ml}$
960	<0.05
1336	<0.05
1416	<0.05

Phenol Analysis - Performed on sample portion marked Phenol + Cu - Acid

Footage	$\mu\text{g/ml}$
960	<0.05
1336	<0.05
1416	<0.05

3

Free NH₃ Analysis - Performed on sample portion marked Hg for N

Footage	µg/ml
960	0.27
1336	0.77
1416	0.65

PO₄ Analysis - Performed on sample portion marked Hg for N

Footage	mg/L P
960	20
1336	<10
1416	<10

Footage	Coliform***	Fecal Coliform***	pH	Color
960	negative	negative	8.31	2
1336	negative	negative	8.44	6
1416	negative	10,000 colonies per 100 ml	8.31	10

***Analysis performed on regular water samples

The remainder of the water analysis including the spark source elemental analysis should be reported shortly. If you have any questions regarding the analysis or procedures, please don't hesitate to call.

S. Sweeney
S. Sweeney, Analyst

M. L. Jacobs
Approved: M. L. Jacobs

cj



The following are a continuation of completed analysis from C & L #97-057-002-11, your sample numbers a) Arco 6-17-74, SG #10 960', b) Arco 6-17-74 SG #10 1336' and c) Arco 6-17-74 SG #10 1416'.

Hg - Performed on sample portion marked "Regular"

<u>Footage</u>	<u>µg/ml. Hg</u>
960	0.0001
1336	0.0003
1416	0.0001

Nitrite & Nitrate - Performed on sample portion marked Hg for N

<u>Footage</u>	<u>µg/L N</u> <u>Nitrate</u>	<u>Nitrite</u>
960	50	<5
1336	60	<5
1416	80	<5

Please note correction on Phosphate Results, µg/L not mg/L

PO₄ - Performed on sample portion marked Hg for M

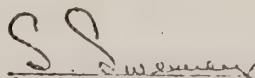
<u>Footage</u>	<u>µg/L P</u>
960	20
1336	<10
1416	<10

Odor Threshold* - Performed on sample portion marked "Regular"

<u>Footage</u>	<u>Threshold</u>
960	0
1336	0
1416	4

*Sample should have been collected in glass bottle.

If you have any questions on these analyses, please feel free to call.


S. Sweeney, Analyst

SS/cj

WATER QUALITY ANALYSES

SG - 11

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-11

Element, mg/l	808.1-Feet		868-Feet		1330-Feet		1385-Feet		2465-Feet		2825-Feet	
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO
Na	163	165	160	141	220	215	240	211	295	488	355	500
K	NA	0.6	NA	0.8	NA	1.3	NA	1.2	NA	1.5	NA	1.8
Ca	62	59	41	33	100	89	26	26	12	18	23	36
Mg	47	43	36	33	79	78	18	18	9	15	14	28
SO ₄	250	316	190	202	455	433	120	86	75	56	195	199
CO ₃	36	9	40	8	<0.1	2	<0.1	14	40	26	43	43
HCO ₃	430	441	370	383	630	620	590	564	570	1036	520	973
Cl	21	8	23	6	28	5	21	3	62	101	115	68
F	0.8	0.4	1.6	1.6	4.0	4.4	11	12	16	14	12	10
Σ Cations, meq/l	14.05	13.68	11.96	10.52	21.07	20.25	13.21	11.99	14.23	23.39	17.76	25.69
Σ Anions, meq/l	14.07	14.34	12.00	11.01	20.58	19.62	12.94	12.22	14.83	22.60	17.89	23.97
% Difference	0.1	2.3	0.1	2.2	1.2	0.9	1.0	0.9	2.1	1.7	0.4	3.8
Silica, mg/l	23	24	22	21	28	19	16	11	16	17	19	19
pH	7.8	8.4	8.0	8.4	7.9	8.2	7.5	8.5	8.0	8.6	8.0	8.6
Calculated TDS, mg/l	814	841	695	634	1223	1150	741	659	804	1244	1030	1382
Measured TDS, mg/l	860	NA	660	NA	1350	NA	720	NA	1320	NA	1530	NA

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building.
Denver, Colorado 80202

Attn: Don Tait

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-1

SAMPLE MARKED: Water SG #11 286.6 Feed 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium (Ca)	120	5.988
Magnesium (Mg)	90	7.407
Sodium (Na)	220	9.440
Carbonate (CO ₃)	24	0.799
Bicarbonate (HCO ₃)	360	5.904
Chloride (Cl)	31	0.874
Sulfate (SO ₄)	690	14.352
Nitrate (NO ₃)	Less than 0.1	-----
Phosphate (PO ₄)	Less than 0.1	-----
Silicon dioxide	34	0.894
Iron (Fe)	0.16	
Fluoride (F)	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	20	
MO alkalinity, in terms of calcium carbonate	295	
Hardness, in terms of calcium carbonate	670	
Total dissolved solids (by evaporation)	1,380	

pH 7.0

Specific conductance 1,810 micromhos per cc

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INSTITUTE OF FUEL TECHNOLOGY
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THE INDUSTRIAL LABORATORIES COMPANY

J. Paul Deeks
CHEMIST

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-2

SAMPLE MARKED: Water SG #11 336.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	130	6.587 6.500
Magnesium	94	7.736
Sodium	240	10.527 10.455
Carbonate	24	0.799
Bicarbonate	360	5.904
Chloride	35	0.987
Sulfate	780	16.224
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	35	0.921
Iron	0.14	-----
Fluoride	Less than 0.1	-----
P. alkalinity, in terms of calcium carbonate	20	Σ cations = 24.67
MO alkalinity, in terms of calcium carbonate	295	Σ anions = 23.61
Hardness, in terms of calcium carbonate	715	ob Diff = 1.6
Total dissolved solids (by evaporation)	1,490	

pH 8.0

Specific conductance 1,870 micromhos per cc

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ASSN OF OFFICIAL BAKING CHEMISTS
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H. Paul Vicks

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-3

SAMPLE MARKED: Water SG #11 7/24/74 386.6 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	130	6.437 6.500
Magnesium	110	8.971 9.053
Sodium	240	10.483 10.435
Carbonate	24	0.799
Bicarbonate	410	6.724
Chloride	42	1.179
Sulfate	770	16.016 16.042
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	45	1.183
Iron	0.05	-----
Fluoride	Less than 0.1	-----
P. alkalinity, in terms of calcium carbonate	20	Σ Calcium: 25.99
MO alkalinity, in terms of calcium carbonate	335	Σ Magnesium: 9.053
Hardness, in terms of calcium carbonate	770	Σ Sodium: 10.435
Total dissolved solids	1,550	
(by evaporation)		
pH	7.9	
Specific conductance	1,960 micromhos per cc	

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BREAD CHEMISTS OF AMERICA
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J. Paul Decker
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ANALYSIS REPORT

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-4

SAMPLE MARKED: Water SG #11 436.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	100	5.090 5.00
Magnesium	130	10.370 5.70
Sodium	240	10.266 10.43
Carbonate	23	0.766
Bicarbonate	500	8.134 8.17
Chloride	35	0.981
Sulfate	730	15.184
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	26	0.684
Iron	0.10	----
Fluoride	Less than 0.1	----
P. alkalinity, in terms of calcium carbonate	19	Σ CaCO ₃ = 26.17
MO alkalinity, in terms of calcium carbonate	410	Σ CaCO ₃ = 25.13
Hardness, in terms of calcium carbonate	770	o.b.t. = 1.9
Total dissolved solids (by evaporation)	1,620	
pH	7.9	
Specific conductance	1,990 micromhos per cc	

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-5

SAMPLE MARKED: Water SG #11 486.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	98	4.890
Magnesium	105	8.806
Sodium	275	11.919
Carbonate	32	1.066
Bicarbonate	570	9.332
Chloride	35	0.981
Sulfate	650	13.520
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	23	0.605
Iron	0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	26	$\Sigma \text{ eq.} = 25.49$
MO alkalinity, in terms of calcium carbonate	470	$\Sigma \text{ eq.} = 24.90$
Hardness, in terms of calcium carbonate	685	$\text{total} = 1.2$
Total dissolved solids	<u>1,700</u>	

pH 7.8

Specific conductance 1,870 micromhos per cc

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ANALYSIS REPORT

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ATLANTIC RICHFIELD

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-6

SAMPLE MARKED: Water SG #11 536.6 Feet 7/24/74

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	88	6.138 4.000
Magnesium	110	9.300 9.053
Sodium	220	9.483 9.565
Carbonate	30	0.999
Bicarbonate	590	9.725 4.272
Chloride	42	1.179
Sulfate	585	12.168
Nitrate	Less than 0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	32	0.842
Iron	Less than 0.05	----
Fluoride	Less than 0.1	----
P. alkalinity, in terms of calcium carbonate	25	2 eq. units 24.02
MO alkalinity, in terms of calcium carbonate	490	2 eq. units 24.02
Hardness, in terms of calcium carbonate	680	3.000 2.01
Total dissolved solids	1,530	
pH	8.0	
Specific conductance	1,840 micromhos per cc	

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H. Paul McNeil
CHEMIST

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-7

SAMPLE MARKED: SG #11 Water 586.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISPOSABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	125	6.138 6.238
Magnesium	88	7.242 11.304
Sodium	260	11.343
Carbonate	24	0.799
Bicarbonate	560	9.233
Chloride	49	1.382
Sulfate	610	12.688 12.703
Nitrate	0.2	----
Phosphate	Less than 0.1	----
Silicon dioxide	24	0.631
Iron	Less than 0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	20	Σ Calcium = 24.78
MO alkalinity, in terms of calcium carbonate	485	Σ Alkalinity = 24.07
Hardness, in terms of calcium carbonate	670	o/b Diff = 1.5
Total dissolved solids (by evaporation)	1,570	
pH	7.8	
Specific conductance	1,850 micromhos per cc	

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BUREAU OF CHEMISTRY, U.S. DEPT. OF AGRICULTURE
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H. Paul Bach
CHEMIST

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-8

SAMPLE MARKED: SG #11 Water 636.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	89	4.441
Magnesium	86	7.078
Sodium	230	10.048
Carbonate	48	1.598
Bicarbonate	530	8.626 2.39
Chloride	32	0.784 0.90
Sulfate	480	9.984 10.31
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	22	0.579
Iron	Less than 0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	39	Σ CaCO ₃ = 21.52
MO alkalinity, in terms of calcium carbonate	430	Σ Alk. = 21.19
Hardness, in terms of calcium carbonate	575	0.0 D.H.C. = 0.7
Total dissolved solids (by evaporation)	1,290	
pH	8.0	
Specific conductance		1,740 micromhos per cc

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J. Paul Phelps
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-9

SAMPLE MARKED: Water SG #11 686.6 Feet 7/24/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	67	3.433
Magnesium	75	6.172
Sodium	250	10.911
Carbonate	42	1.399
Bicarbonate	480	7.839
Chloride	35	0.987
Sulfate	450	9.360
Nitrate	0.2	----
Phosphate	Less than 0.1	----
Silicon dioxide	32	0.842
Iron	Less than 0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	34	20.34
MO alkalinity, in terms of calcium carbonate	390	19.62
Hardness, in terms of calcium carbonate	475	1.9
Total dissolved solids (by evaporation)	1,170	
pH	8.0	
Specific conductance	1,610 micromhos per cc	

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-10

SAMPLE MARKED: Water SG #11 737.1 Feet 7/25/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	57	2.844
Magnesium	48	3.950
Sodium	230	10.092
Carbonate	30	0.999
Bicarbonate	420	6.839
Chloride	28	0.784
Sulfate	360	7.488
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	30	0.789
Iron	Less than 0.05	
Fluoride	0.1	
P. alkalinity, in terms of calcium carbonate	25	
MO alkalinity, in terms of calcium carbonate	340	
Hardness, in terms of calcium carbonate	340	
Total dissolved solids (by evaporation)	980	

pH 8.1

Specific conductance 1,340 micromhos per cc

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H. Paul Ocker
CHEMIST

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-11

SAMPLE MARKED: Water SG #11 786.5 Feet 7/25/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. REPAIRABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	34	1.697
Magnesium	48	3.950
Sodium	190	8.265
Carbonate	40	1.332
Bicarbonate	360	5.904
Chloride	35	0.987
Sulfate	240	4.992
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	26	0.684
Iron	Less than 0.05	
Fluoride	0.6	
P. alkalinity, in terms of calcium carbonate	33	
MO alkalinity, in terms of calcium carbonate	295	
Hardness, in terms of calcium carbonate	280	
Total dissolved solids	870	

Σ Ca = 13.91
Σ Mg = 13.22
of Ca = 2.5

pH 8.2
Specific conductance 1,140 micromhos per cc

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AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
ASSN. OF OIL FIELD RECORD CHEMISTS
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J. Paul Schaefer
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Analytical and Consulting Chemists

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

DATE RECEIVED: 8/2/74
DATE REPORTED: 8/7/74

LAB. NUMBER: 1842

Attn: Don Tait

SAMPLE MARKED: S.G. #11 808.1' 7/27

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium (Ca)	62
Magnesium (Mg)	47
Sodium (Na)	163
Carbonate (CO ₃)	36
Bicarbonate (HCO ₃)	430
Chloride (Cl)	21
Sulfate (SO ₄)	250
Nitrate (NO ₃)	1.7
Phosphate (PO ₄)	Less than 0.1

MILLI-EQUIVALENTS

	3.09	pH	7.8
Calcium = 14.25	3.87		
Magnesium = 14.27	7.69	Turbidity	
Sodium = 0.07	1.20	Less than 1 unit	
	7.05		
	0.59		
	5.20		
	0.60	2.23	

MILLIGRAMS PER LITER

Silicon dioxide (SiO ₂)	23
Fluoride (F)	0.8
Iron (Fe)	Less than 0.05
P. alkalinity, in terms of calcium carbonate	29
MO alkalinity, in terms of calcium carbonate	350
Hardness, in terms of calcium carbonate	350
Phenols	0.005
Cyanide (Cn)	Less than 0.01
Nitrite (NO ₂)	Less than 0.1
Sulfur (S)	Less than 0.05
Lithium (Li)	Less than 1.0
Beryllium (Be)	Less than 1.0
Hexavalent chromium	Less than 0.01
Arsenic (As)	Less than 0.01
Selenium (Se)	Less than 0.01
Cadmium (Cd)	Less than 0.01

Mercury (Hg)	Less than 0.01
Copper (Cu)	Less than 0.1
Boron (B)	Less than 0.1
Lead (Pb)	Less than 0.05
Manganese (Mn)	Less than 0.05
Silver (Ag)	Less than 0.01
Zinc (Zn)	Less than 0.5
Hydroxide (OH)	Less than 0.1
Residual chlorine	Less than 0.1
Molybdenum (Mo)	Less than 0.1
Barium (Ba)	Less than 1.0
Total dissolved solids	860

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J. Paul Ochs
CHEMIST

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-12

SAMPLE MARKED: Water SG #11 836.6 Feet 7/27/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	89	2.695
Magnesium	86	3.539
Sodium	230	8.178
Carbonate	48	1.532
Bicarbonate	525	6.347
Chloride	31	0.790
Sulfate	48	4.992
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	22	0.657
Iron	Less than 0.05	
Fluoride	Less than 0.1	
P. alkalinity, in terms of calcium carbonate	39	Σ eq. val. = 24.53
MO alkalinity, in terms of calcium carbonate	430	Σ eq. val. = 12.68
Hardness, in terms of calcium carbonate	575	o.b.d. = 28.1
Total dissolved solids (by evaporation)	900	
pH	8.0	
Specific conductance	1,160 micromhos per cc	

MEMBERS OF:

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H. Paul Vicks

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD

DATE RECEIVED: 8/2/74

DATE REPORTED: 8/7/74

LAB. NUMBER: 1843

SAMPLE MARKED: S.G. #11 868.0 Feet 7/27/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. REUSABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium	41
Magnesium	36
Sodium	160
Carbonate	40
Bicarbonate	370
Chloride	23
Sulfate	190
Silicon dioxide	22
Nitrate	3.5
Phosphate	Less than 0.1
Fluoride	1.6
Iron	Less than 0.05
P. alkalinity, in terms of calcium carbonate	33
NO alkalinity, in terms of calcium carbonate	300
Hardness, in terms of calcium carbonate	250
Phenols	Less than 0.001
Cyanide	Less than 0.01
Nitrite	Less than 0.1
Sulfur	Less than 0.05
Lithium	Less than 1.0
Barium	Less than 1.0
Ammonia-nitrogen	0.9
Hexavalent chromium	Less than 0.01
Arsenic	Less than 0.01
Selenium	Less than 0.01

MILLI-EQUIVALENTS

2.04	pH	8.0
2.96		
7.57	Turbidity	Less than 1 unit
1.33		
6.07		
0.65		
3.95		
0.58		

MILLIGRAMS PER LITER

Cadmium	Less than 0.01
Copper	Less than 0.01
Boron	Less than 0.1
Lead	Less than 0.05
Manganese	Less than 0.05
Silver	Less than 0.01
Zinc	Less than 0.5
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Residual chlorine	Less than 0.1
Molybdenum	Less than 0.1
Beryllium	Less than 0.1
Total dissolved solids	650

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J. Paul Ochoa
CHEMIST

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74
DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-13

SAMPLE MARKED: Water SG #11 885 Feet 7/27/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	29	1.447
Magnesium	46	3.786
Sodium	175	7.656 7.208
Carbonate	Less than 0.1	----
Bicarbonate	400 ✓	6.544
Chloride	42	1.184
Sulfate	225 ✓	4.680
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	18	0.473
Iron	0.16	
Fluoride	2.8	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	Σ eq. ions = 12.5
MO alkalinity, in terms of calcium carbonate	330	Σ eq. ions = 12.4
Hardness, in terms of calcium carbonate	260	total = 1.7
Total dissolved solids (by evaporation)	810	
pH	7.9	
Specific conductance	1,140 micromhos per cc	

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INSTITUTE OF FOOD TECHNOLOGY
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H. Paul Deha
CHEMIST

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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-14

SAMPLE MARKED: Water SG #11 925 Feet 7/28/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	19	0.948
Magnesium	49	4.033
Sodium	165	7.090
Carbonate	22	0.733
Bicarbonate	395	6.445
Chloride	21	0.592
Sulfate	185✓	3.890
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	15	0.395
Iron	0.18	
Fluoride	4.6	12.07
P. alkalinity, in terms of calcium carbonate	18	11.66
MO alkalinity, in terms of calcium carbonate	320	1.7
Hardness, in terms of calcium carbonate	250	
Total dissolved solids	760	
pH	8.1	
Specific conductance	1,050 micromhos per cc	

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AMERICAN OIL CHEMISTS SOCIETY
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ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/3/74

DATE REPORTED: 8/9/74

LAB. NUMBER: 1864-15

SAMPLE MARKED: Water SG #11 925 Feet 7/29/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	9.8	0.489
Magnesium	33	2.716
Sodium	160	7.039 6.951
Carbonate	24	0.799
Bicarbonate	365	6.002 5.933
Chloride	28	0.784
Sulfate	100	2.080
Nitrate	0.1	----
Phosphate	Less than 0.1	----
Silicon dioxide	22	0.579
Iron	0.32	
Fluoride	1.2	
P. alkalinity, in terms of calcium carbonate	20	Σ eq. val. = 10.16
MO alkalinity, in terms of calcium carbonate	300	Σ eq. val. = 9.65
Hardness, in terms of calcium carbonate	160	Σ eq. val. = 2.6
Total dissolved solids (by evaporation)	580	
pH	8.2	
Specific conductance	860 micromhos per cc	

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ASSOCIATION OF FOOD INSPECTING CHEMISTS
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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-3

SAMPLE MARKED: GG #11 7/29/74 1,025 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

MILLI-EQUIVALENTS

Calcium	25
Magnesium	26
Sodium	155
Carbonate	Less than 0.1
Bicarbonate	410
Chloride	24
Sulfate	125
Nitrate	0.4
Phosphate	Less than 0.1
Silicon dioxide	21
Iron	0.05
Fluoride	5
P. alkalinity, in terms of calcium carbonate	Less than 0.1
MO alkalinity, in terms of calcium carbonate	335
Hardness, in terms of calcium carbonate	170
Total dissolved solids	565

1.247
2.140
6.743

6.724

0.677
2.579

0.552

Σ cation = 10.13
 Σ anion = 9.98
diff. = 0.15

pH 7.7

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202

Attn: John Matis

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-1

SAMPLE MARKED: GG #11 7/30/74 1,075 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium (Ca)	21	1.048
Magnesium (Mg)	24	1.975
Sodium (Na)	185	8.048
Carbonate Less than	0.1	-----
Bicarbonate (HCO ₃)	435	7.134
Chloride (Cl)	25	0.705
Sulfate (SO ₄)	120	2.538 2.500
Nitrate (NO ₃)	5.3	-----
Phosphate (PO ₄) Less than	0.01	-----
Silicon dioxide (SiO ₂)	24	0.631
Iron (Fe)	0.11	
Fluoride (F)	6	Σ Ca-mg = 11.07
P. alkalinity, in terms of calcium carbonate Less than	0.1	Σ Anion = 10.35
MO alkalinity, in terms of calcium carbonate	355	o/p Dis = 3.2
Hardness, in terms of calcium carbonate	150	
Total dissolved solids	640	

pH 7.8

MEMBERS OF:

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J. Paul Deha
CHEMIST

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Analytical and Consulting Chemists

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/9/74

DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-2

SAMPLE MARKED: GG #11 7/30/74 1,125 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	23	1.148
Magnesium	23	1.893
Sodium	175	7.613
Carbonate	Less than 0.1	-----
Bicarbonate	440	7.216
Chloride	20	0.564
Sulfate	110	2.288
Nitrate	11	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	20	0.526
Iron	0.25	
Fluoride	7	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	$\Sigma \text{ eq. val.} = 10.65$
MO alkalinity, in terms of calcium carbonate	360	$\Sigma \text{ eq. val.} = 10.07$
Hardness, in terms of calcium carbonate	150	$\text{pH} = 7.8$
Total dissolved solids	625	

pH 7.8

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IOWA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Ochs
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/9/74
DATE REPORTED: 8/16/74

LAB. NUMBER: 2012-4

SAMPLE MARKED: GG #11 7/31/74 1,185 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERSHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	9.8	0.489
Magnesium	23	1.893
Sodium	235	10.223
Carbonate	Less than 0.1	----
Bicarbonate	570	9.348
Chloride	27	0.761
Sulfate	95	1.976
Nitrate	0.4	----
Phosphate	0.4	----
Silicon dioxide	21	0.552
Iron	Less than 0.05	
Fluoride	9	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	Σ Ca-ions = 12.61
MO alkalinity, in terms of calcium carbonate	470	Σ anions = 12.09
Hardness, in terms of calcium carbonate	120	0.5, 2.1
Total dissolved solids	610	
pH	7.8	

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74

DATE REPORTED: 8/27/74

LAB. NUMBER: 2312

SAMPLE MARKED: SG #11 1,330 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

MILLIGRAMS PER LITER

Calcium	100
Magnesium	79
Sodium	220
Carbonate	Less than 0.1
Bicarbonate	630
Chloride	28
Sulfate	455
Nitrate	Less than 0.1
Phosphate	Less than 0.1
Silicon dioxide	28
Iron	Less than 0.05
Fluoride	4.0
P. alkalinity, in terms of calcium carbonate	Less than 0.1
MO alkalinity, in terms of calcium carbonate	520
Hardness, in terms of calcium carbonate	580
C.O.D.	17
Ammonia-nitrogen	Less than 0.1
MB-AS	Less than 0.5
Phenols	Less than 0.001
Cyanide	Less than 0.01
Hydrogen sulfide	Less than 0.1
Nitrite	Less than 0.1
Lithium	Less than 5
Barium	Less than 1
Hexavalent chromium	Less than 0.01

MILLI-EQUIVALENTS

5.090	5.000
6.502	
9.758	9.500

10.332	

0.790	
9.464	Σ eq = 21.07
-----	Σ eq = 20.58
-----	Σ eq = 1.2
0.764	

MILLIGRAMS PER LITER

Arsenic	0.03
Selenium	Less than 0.01
Boron	1.0
Manganese	Less than 0.05
Mercury	Less than 0.01
Hydroxide	Less than 0.1
Total dissolved solids	1,350

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TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 8/23/74

DATE REPORTED: 8/27/74

LAB. NUMBER: 2313

SAMPLE MARKED: SG #11 1,385 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	26	1.297
Magnesium	18	1.481
Sodium	240	10.616 <i>12.135</i>
Carbonate	Less than 0.1	-----
Bicarbonate	590	9.676
Chloride	21	0.592
Sulfate	120	2.496 <i>2.496 = 13.21</i>
Nitrate	Less than 0.1	----- <i>= 12.94</i>
Phosphate	Less than 0.1	----- <i>0.014 = 1.0</i>
Silicon dioxide	16	0.421
Iron	Less than 0.05	-----
Fluoride	11	0.177
Ammonia-nitrogen	0.3	
P. alkalinity, in terms of calcium carbonate	Less than 0.1	
MO alkalinity, in terms of calcium carbonate	470	
Hardness, in terms of calcium carbonate	140	
C.O.D.	14	
MB-AS	Less than 0.05	
Phenols	Less than 0.001	
Cyanide	Less than 0.01	
Hydrogen sulfide	Less than 0.1	
Nitrite	Less than 0.1	
Lithium	Less than 5	
Barium	Less than 1	
Hexavalent chromium	Less than 0.01	
		MILLIGRAMS PER LITER
		Arsenic 0.02
		Selenium Less than 0.01
		Boron 1.6
		Manganese Less than 0.05
		Mercury Less than 0.01
		Hydroxide Less than 0.1
		Total dissolved solids 720
		pH 7.5
		Turbidity 2 units

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ATLANTIC RICHFIELD

DATE RECEIVED: 9/11/74
DATE REPORTED: 9/17/74

LAB. NUMBER: 2702

SAMPLE MARKED: SG #11 Depth 2,465 feet Tap GG

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	12		0.599
Magnesium	9		0.741
Sodium	295		12.906
Carbonate	40		1.332
Bicarbonate	570		9.184 9.344
Chloride	62		1.748 2.14.23
Sulfate	75		1.560 2.14.23
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	16		0.421 0.6.11
Iron	Less than 0.05		0.342
Fluoride	16		MILLIGRAMS PER LITER
P. alkalinity, in terms of calcium carbonate	33	Boron	0.4
NO alkalinity, in terms of calcium carbonate	460	Mercury	Less than 0.01
Hardness, in terms of calcium carbonate	67	Hydroxide	Less than 0.1
		Cadmium	0.01
		Copper	Less than 0.10
C.O.D.	40	Lead	0.05
Phenols	Less than 0.001	Manganese	Less than 0.05
Cyanide	Less than 0.01	Silver	Less than 0.01
Nitrite	0.1	Zinc	Less than 0.5
Sulfide	1.7	Total dissolved solids	1,320
		Calc.	804
Hexavalent chromium	Less than 0.01	pH	8.0
Arsenic	L 0.01	Turbidity	Less than 1 unit
Selenium	Less than 0.01		
Lithium	Less than 0.5		
Barium	Less than 1.0		

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ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
2 Park Central, Suite 555
1515 Arapahoe Street
Denver, Colorado 80202
Attn: John Matis

DATE RECEIVED: 9/11/74
DATE REPORTED: 9/17/74
LAB. NUMBER: 2701

SAMPLE MARKED: SG #11 TD 2825 feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER	MILLI-EQUIVALENTS
Calcium	23	1.148
Magnesium	14	1.152
Sodium	355	15.458
Carbonate	43	1.431
Bicarbonate	520	8.528
Chloride	115	3.243
Sulfate	195	4.056
Nitrate	Less than 0.1	-----
Phosphate	Less than 0.1	-----
Silicon dioxide	19	0.500
Ammonia-nitrogen	0.2	
Iron	Less than 0.05	
Fluoride	12	
P. alkalinity, in terms of calcium carbonate	35	
MO alkalinity, in terms of calcium carbonate	425	
Hardness, in terms of calcium carbonate	115	
C.O.D.	40	
Phenols	Less than 0.01	
Cyanide	Less than 0.01	
Nitrite	Less than 0.1	
Sulfide	0.8	
Hexavalent chromium	Less than 0.01	
Arsenic	0.02	
Selenium	Less than 0.01	
Lithium	Less than 0.5	
Barium	Less than 1.0	
Boron		Less than 0.1
Mercury		Less than 0.01
Hydroxide		Less than 0.1
Cadmium		Less than 0.01
Copper		Less than 0.1
Lead		0.09
Manganese		Less than 0.05
Silver		Less than 0.01
Zinc		Less than 0.5
Total dissolved solids		1,530
		Calc. 1,030
pH		8.0
Turbidity		Less than 1 unit

$\Sigma \text{ Ca}^{++} = 17.76$
 $\Sigma \text{ Mg}^{++} = 17.39$
 $\% \text{ Ca} = 0.4$

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C & L LABORATORIES

General Analytical Services

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401
Customer No.:
Sample No.: SG #11 808.1

Date: 8-16-74

Analyst: S. Sweeney

C & L No.: 97-089-002-02

14335 West 44th Ave
Golden, Colo. 80401
(303) 270-9521

CONCENTRATION IN XXXXXXX		CONC.		CONC.		CONC.	
ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.01
Thorium		Gadolinium		Molybdenum	0.2	Titanium	0.2
Bismuth		Europium		Niobium	0.005	Scandium	0.008
Lead		Samarium		Zirconium		Calcium	MC
Thallium		Neodymium		Yttrium		Potassium	1.5
Mercury *	0.88	Praseodymium		Strontium	7	Chlorine	=20
Gold		Cerium		Rubidium	0.008	Sulfur	MC
Platinum		Lanthanum		Bromine	0.03	Phosphorus	1
Iridium		Barium	0.04	Selenium		Silicon	4
Osmium		Cesium	0.007	Arsenic	0.03	Aluminum	0.6
Rhenium		Iodine	0.01	Germanium		Magnesium	MC
Tungsten		Tellurium		Gallium	0.01	Sodium	MC
Tantalum	**	Antimony		Zinc	0.06	Fluorine	=19
Hafnium		Tin		Copper	0.3	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.07	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.03	Carbon	NR
Thulium		Silver		Iron	0.7	Boron	0.02
Erbium		Palladium		Manganese	0.4	Beryllium	
Holmium		Rhodium		Chromium	0.09	Lithium	0.4
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported XXXXXXXXXX

**Source Contamination

<0.001 ug/ml

*Flameless Atomic Absorption

C & L LABORATORIES

Elemental Analysis - Mass Spectrometry

General Analytical Services

To: Mr. Frank Haas
The Oil Shale Corp.
18200 West Hiway 72
Golden, CO 80401

Date: 8-15-74

14335 West 44th Ave
Golden, Colo. 80401
(303) 270-9521

Analyst: S. Sweeney

Customer No.:

C & L No.: 97-087-002-02

Sample No.: SG #11 868.0'

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum		Titanium	0.1
Bismuth		Europium		Niobium		Scandium	0.003
Lead		Samarium		Zirconium		Calcium	=28
Thallium		Neodymium		Yttrium		Potassium	1
Mercury ***	0.00095	Praseodymium		Strontium	3	Chlorine	15
Gold		Cerium		Rubidium	0.01	Sulfur	=28
Platinum		Lanthanum		Bromine	0.03	Phosphorus	1
Iridium		Barium	0.04	Selenium		Silicon	3
Osmium		Cesium	0.007	Arsenic	0.02	Aluminum	2
Rhenium		Iodine	0.03	Germanium		Magnesium	0.01
Tungsten		Tellurium		Gallium		Sodium	MC
Tantalum **		Antimony		Zinc	0.1	Fluorine	=4
Hafnium		Tin		Copper	0.06	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.02	Carbon	NR
Thulium		Silver	<	Iron *	0.5	Boron	0.02
Erbium		Palladium		Manganese	0.08	Beryllium	0.0005
Holmium		Rhodium		Chromium	0.03	Lithium	0.06
Dysprosium						Hydrogen	NR

NR - Not Reported <0.001 $\mu\text{g/ml}$
All elements not reported

**Source Contamination

***Flameless Atomic Absorption

*Heterogeneous

WATER QUALITY ANALYSES

SG - 18

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES
CORE HOLE SG-18

<u>Component, mg/l</u>	<u>960-feet</u> <u>Industrial</u>	<u>1380-feet</u>		<u>1425.6-feet</u> <u>Industrial</u>	<u>J.G.G. 11-1-74</u> <u>TOSCO</u>
		<u>Industrial</u>	<u>TOSCO</u>		
Na	169	190	167	176	135
K	NA	NA	0.4	NA	0.4
Ca	51	7.4	4	18	24
Mg	6.1	5.7	4	11	30
SO ₄	74	4.0	1	42	84
CO ₃	17	<0.1	3	<0.1	0
HCO ₃	460	496	462	460	471
Cl	6.8	0.7	1	1.4	3
F	9.1	10.1	13	9.9	5.4
ΣCations, meq/l	10.40	9.10	7.80	9.46	9.55
ΣAnions, meq/l	10.13	8.66	8.40	8.94	9.84
% Difference	1.3	2.5	3.7	2.8	1.5
Silica, mg/l	21	13	13	17	23
pH	8.3	8.0	8.3	8.0	8.2
Calculated TDS, mg/l	579	474	433	501	536

NA - Not Analyzed

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2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3541

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74

DATE REPORTED: 11/4/74

LAB. NUMBER: 3737

SAMPLE MARKED: Sorghum Gulch #18 550 Feet Top of Parachute Creek

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. REMARKABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	51		2.545
Magnesium	6.1		0.502
Sodium	169		7.362
Carbonate	17		0.565
Bicarbonate	459	Σ cations = 10.40	7.544
		Σ anions = 10.13	
		% Diff = 1.3	
Chloride	6.8		-----
Sulfate	74		1.539
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	21		0.699
Iron	0.32		-----
Fluoride	9.1		0.432
P. alkalinity, in terms of calcium carbonate	---		MILLIGRAMS PER LITER
MO alkalinity, in terms of calcium carbonate	---	Aluminum	3.2
Hardness, in terms of calcium carbonate	152	Copper	Less than 0.1
Total dissolved solids	557	Cadmium	Less than 0.01
		Lead	Less than 0.05
		Manganese	Less than 0.05
Ammonia	0.2		
Lithium	Less than 0.5	Silver	Less than 0.01
Barium	Less than 1.0	Zinc	Less than 0.5
Peroxivalent chromium	Less than 0.01	Mercury	Less than 0.01
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.4	pH	8.3
Hydroxide	Less than 0.1	Specific conductance	710 micromhos per cc

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ATLANTIC RICHFIELD

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/18/74

LAB. NUMBER: 3752

SAMPLE MARKED: San Juan Gulch #18 1,380 Feet 10/3/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERSHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	7.4		0.369
Magnesium	5.7		0.469
Sodium	190	Σ cations = 9.10	8.265
Carbonate	Less than 0.1	Σ anions = 8.66	-----
Bicarbonate	493	% Diff = 2.5	8.134
Chloride	0.7		-----
Sulfate	4.0		-----
Nitrate	Less than 0.1		-----
Phosphate	Less than 0.1		-----
Silicon Dioxide	13		0.433
Iron	0.06		-----
Fluoride	10.1		0.530
Hardness, in terms of calcium carbonate	42		
Ammonia	0.3		
Lithium	Less than 0.5	Silver	Less than 0.5
Barium	Less than 1.0	Mercury	Less than 0.01
Hexavalent chromium	Less than 0.01	Total dissolved solids	473
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.6	pH	8.0
Hydroxide	Less than 0.1	Specific conductance	670 micromhos per cc
Aluminum	Less than 0.05		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		
Manganese	Less than 0.05		

MEMBERS OF: cc: John Hatis/Frank Haas

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DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY
1500 Security Life Building
Denver, Colorado 80202

Attn: Don Taft

DATE RECEIVED: 10/17/74
DATE REPORTED: 10/23/74

LAB. NUMBER: 3761

SAMPLE MARKED: Sorghum Gulch #10 1425.6 Feet 10/5/74

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. DISCARDABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	12		0.898
Magnesium	11		0.905
Sodium	176	Σ cations = 9.46	7.656
Carbonate	Less than 0.1	Σ anions = 8.94	-----
Bicarbonate	460	% Diff = 2.8	7.544
Chloride	1.4		-----
Sulfate	42		0.874
Nitrate	0.1		-----
Phosphate	Less than 0.1		-----
Silicon dioxide	17		0.566
Iron	0.03		-----
Fluoride	9.9		0.523
Hardness, in terms of calcium carbonate	90		
Ammonia	0.3		
Lithium	Less than 0.5	Manganese	Less than 0.03
Barium	Less than 1.0	Zinc	Less than 0.5
		Mercury	Less than 0.01
Hexavalent chromium	Less than 0.01	Total dissolved solids	485
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.4	pH	8.0
Hydroxide	Less than 0.1	Specific conductance	750 micromhos per cc
Aluminum	0.8		
Copper	Less than 0.1		
Cadmium	Less than 0.01		
Lead	Less than 0.05		
Silver	Less than 0.01		

MEMBERS OF: cc: John Matis/Frank Haas

AMERICAN ASSOCIATION OF CHEMICAL ANALYSTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS SOCIETY
ASSOCIATION OF APPLIED POLYMER SCIENTISTS
FEDERAL BUREAU OF ANALYSIS
INSTITUTE OF FOOD TECHNOLOGY
SIEMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Wells
CHEMIST

OCT 30 1974

TOLSON-GOLDEN

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COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-0434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

20 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, CO 80401

Re: IAD #97-153-002-94

ANALYTICAL REPORT

	TOC* mg/liter	Nitrates** mg/liter N
Aquifer Test #1 after pumping 15 hrs.	<1	0.34
Well 1-C String #2	8	0.10
✓ ARCO SG #18-A T.D. 1330' JGC 11-1-74	<1	0.22
ARCO SG-9 2750'	<1	0.056 ✓

*Test performed on samples marked "Regular" and
run by an outside laboratory.

**Test performed on samples marked "Hg for N"

Charles R. Wilson
Charles R. Wilson
Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs Ph.D.
Divisional Manager

CRW/hb

RECEIVED

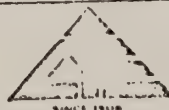
NOV 25 1974

WOSCO-GOLDEN

CHICAGO, IL • CHARLESTON, WV • CLARKSBURG, WV • CLEVELAND, OH • NORFOLK, VA • TERRE HAUTE, IN • HENDERSON, KY • DENVER, CO • BIRMINGHAM, AL • VANCOUVER, B.C. CAN.

COMMERCIAL TESTING & ENGINEERING CO.

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Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

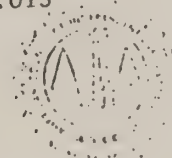
12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
✓ ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
✓ ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
ARCO SG #19 @ 860'	4	0.21	0.018
ARCO SG #19 TD @ 981'	3	0.34	0.040
SG #9 Top of Mining Zone 1285'	3	3.35	0.025
✓ SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013



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Mr. Frank Haas
12 November 74
Page 2

- * Test performed on samples marked 'Regular'
- ** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs, Ph.D.
Divisional Manger

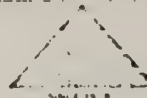
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INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #18 960' Top of
para cr. 800 mΩ CONCENTRATION IN µg/ml

IAD No.: 97-140-002-33

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.04	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	.
Lead	0.07	Samarium		Zirconium	0.01	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	2	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.2
Iridium		Barium	0.01	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.008	Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.2	Fluorine	*
Hafnium		Tin		Copper	0.008	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	2	Boron	0.03
Erbium		Palladium		Manganese	0.04	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	0.2
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported < 0.02 µg/ml

* Not reported upon request

** Flameless Atomic Absorption

Approved:

M. J. [Signature]

COMMERCIAL TESTING & ENGINEERING CO.

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INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-279-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. SG #18 c-b @ 1380'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.004
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	
Lead	0.04	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.005	Rubidium	0.005	Sulfur	*
Platinum		Lanthanum		Bromine	0.005	Phosphorus	0.2
Iridium		Barium	0.05	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.01	Aluminum	0.9
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.009	Fluorine	*
Hafnium		Tin		Copper	0.008	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.006	Nitrogen	NR
Ytterbium		Cadmium		Cobalt		Carbon	NR
Thulium		Silver		Iron	0.5	Boron	0.01
Erbium		Palladium		Manganese	0.01	Beryllium	<0.001
Holmium		Rhodium		Chromium	0.01	Lithium	0.2
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported <0.007 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

M. Sweeney

COMMERCIAL TESTING & ENGINEERING CO.

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INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: SG #18 Base of Mining Zone TD
1425.6 (800m Ω)

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.02	Titanium	0.1
Bismuth		Europium		Niobium		Scandium	
Lead	0.09	Samarium		Zirconium	0.006	Calcium	*
Thallium		Neodymium		Yttrium	0.003	Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.8	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	0.4
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.008	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.004	Carbon	NR
Thulium		Silver		Iron	2	Boron	0.02
Erbium		Palladium		Manganese	0.07	Beryllium	
Holmium		Rhodium		Chromium	0.01	Lithium	1
Dysprosium						Hydrogen	NR

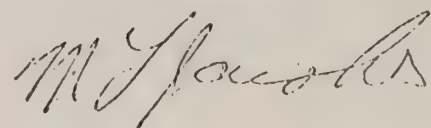
NR -- Not Reported

All elements not reported $<0.003 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:



4601 Indiana Street
Golden, Colorado 80401

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

2562

Analysis No.	Sample Description	α		β		β		pCi/l		Ra ²²⁶	Precision*	Precision*
		Total \pm	Precision*	Total \pm	Precision*	Total \pm	Precision*	pCi/l	pCi/l			
7515-21	9 Bottom-1360'	1.5 \pm	2.7	0		\pm	15					
-22	Top of parachute 9 Creek-993'	3.4 \pm	2.1	0		\pm	13					
-23	Top of mining zone 9-1285'	5.7 \pm	2.7	0		\pm	14		0.9	\pm	0.6	
-24	A-10 67'	2.3 \pm	2.5	0		\pm	14					
-25	A-11 66'	2.2 \pm	2.6	0		\pm	14					
-26	A-11 66'	5.0 \pm	3.2	0		\pm	15		0	\pm	0.3	
-27	A-12 78'	1.6 \pm	2.4	0		\pm	14					
-28 ✓	18-Base 1425.6'	4.0 \pm	2.2	0		\pm	13					
-29 ✓	18-1360'	1.8 \pm	1.9	0		\pm	13					
-30 ✓	Top of para. 18-960'	0.6 \pm	1.7	0		\pm	13					
-31	Top of para. 19-466'	2.8 \pm	2.1	0		\pm	13					
-32	19-860'	0.7 \pm	2.6	0		\pm	15					
-33	19-TD-981'	0 \pm	3.4	0		\pm	33					

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

By: *John C. Jarvis*
John C. Jarvis
Manager, Analytical Laboratory

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. F. C. Haas
The Oil Shale Corporation
18200 West Highway 72
Golden, Colorado 80401

Date: December 3, 1974
HRI Project No. 535
HRI Series No. 7559
Samples received: November 1, 1974

REPORT OF ANALYSIS

Analysis No.	Sample Designation	α pCi/l		β pCi/l		β Precision*		^{226}Ra pCi/l		^{226}Ra \pm Precision*	
		Total	\pm	Total	\pm	Precision*		Total	\pm	Precision*	
7559-1	Aquifer Test #1 Pumped 15 hrs.	4.2	\pm	0	\pm	11		0.3	\pm	0.5	
-2	Well #1-C String #2	0.6	\pm	9	\pm	12					
-3	SG-9 2750'	5.5	\pm	0	\pm	11		0	\pm	0.4	
-4	SG-18-A TD 1380 JGG 11-1-74	8.0	\pm	0	\pm	11		0.1	\pm	0.4	

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

11b

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

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DEC 4 1974

HAZEN RESEARCH, INC.

COMMERCIAL TESTING & ENGINEERING CO.

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INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colo. 80401

Date: 20 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO Sg #18-A T.D. 1380'

IAD No.: 97-153-002-04

30
JGC 11-1-74 µg/ml
CONCENTRATION IN ~~PERCENTAGE~~

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.001
Thorium		Gadolinium		Molybdenum	0.03	Titanium	0.04
Bismuth		Europium		Niobium		Scandium	0.003
Lead	<0.02	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	** 0.0024	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium		Rubidium	0.004	Sulfur	*
Platinum		Lanthanum		Bromine	0.01	Phosphorus	0.3
Iridium		Barium	0.03	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.02	Aluminum	0.5
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.005	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.001	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.02
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.001	Lithium	0.3
Dysprosium						Hydrogen	NR

NR -- Not Reported <0.007 µg/ml

All elements not reported <0.007 µg/ml

*Not reported upon request

**Flameless Atomic Absorption

Approved:

M. Jacobs

WATER QUALITY ANALYSES

SG - 19

TRACT C-b

TABLE 1

MAJOR CONSTITUENT ANALYSES, CORE HOLE SG-19

Component, mg/l	466-feet		860-feet		981-feet		J.G.G. 11-1-74 TOSCO
	Industrial	TOSCO	Industrial	TOSCO	Industrial	TOSCO	
Na	220	198	527	489	762	722	762
K	NA	0.4	NA	0.6	NA	0.9	1.1
Ca	8.6	4	7.8	3	11	4	4
Mg	1.3	3	0.9	2	<0.1	3	3
SO ₄	9.4	15	<4	0	<4	0	0
CO ₃	17	5	81	27	70	19	50
HCO ₃	480	516	1160	1151	1750	1820	1173
Cl	9.5	3	6.8	6	<0.1	10	12
F	9.3	4	10	16	10	22	23
Σ Cations, meq/l	10.11	9.07	23.39	21.59	33.70	31.86	33.61
Σ Anions, meq/l	9.39	8.92	22.44	20.78	31.72	31.91	32.28
% Difference	3.7	0.8	2.1	1.9	3.0	0.1	2.0
Silica, mg/l	10	14	11	11	8.4	10	9
pH	8.3	8.3	8.7	8.5	8.6	8.4	8.7
Calculated TDS, mg/l	520	499	1213	1119	1724	1681	1733

NA - Not analyzed

THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 12/1/77
DATE REPORTED: 12/1/77

LAB. NUMBER: 3710

SAMPLE MARKED: Sor Num Gulch #19 456 Feet Top of Parachute
Creek

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF
REPORT UNLESS WE ARE REQUESTED, IN WRITING,
TO RETAIN THEM FOR A LONGER PERIOD. DISCARD-
ABLE SAMPLES ARE USUALLY DISCARDED IMMEDI-
ATELY UNLESS CLIENT HAS REQUESTED SPECIAL
HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	8.6		0.420
Magnesium	1.3		0.187
Sodium	220		9.570
Carbonate	17	Σ cations = 10.11	3.466
Bicarbonate	460	Σ anions = 9.39	7.872
		% Diff = 3.7	
Chloride	9.5		0.265
Sulfate	9.4		0.183
Nitrate	2.3		---
Phosphate	Less than 0.1		---
Silicon dioxide	10		0.333
Iron	1.06		---
Fluoride	9.3		0.493
P. alkalinity, in terms of calcium carbonate	---		MILLIGRAMS PER LITER
M alkalinity, in terms of calcium carbonate	---	Aluminum	5.4
Hardness, in terms of calcium carbonate	27	Copper	Less than 0.1
Total dissolved solids	522	Cadmium	Less than 0.01
		Lead	Less than 0.05
		Manganese	Less than 0.05
Ammonia	0.3		
Lithium	Less than 0.5	Silver	Less than 0.01
Barium	Less than 1.0	Zinc	Less than 0.5
Hexavalent chromium	Less than 0.01	Mercury	Less than 0.01
Iodide	Less than 0.01		
Selenium	Less than 0.01	pH	5.3
Iron	0.4	Specific conductance	720 micromhos per cc
Hydroxide	Less than 0.1		

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AMERICAN OIL CHEMISTS' SOCIETY
ASSN. OF OFFICIAL AGENCIES CHEMISTS
BATTERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Wells
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 3786

SAMPLE MARKED: Sorghum 083ch #10 250 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	7.8		0.389
Magnesium	0.9		0.074
Sodium	527		22.925
Carbonate	81	Σ cations = 23.39	2.657
Bicarbonate	1,160	Σ anions = 22.44	19.024
		% Diff = 2.1	
Chloride	6.3		---
Sulfate	Less than 4.0		---
Nitrate	Less than 0.3		---
Phosphate	Less than 0.1		---
Silicon dioxide	11		0.366
Iron	1.0		---
Fluoride	10		0.523
P. alkalinity, in terms of calcium carbonate	---		MILLIGRAMS PER LITER
MO alkalinity, in terms of calcium carbonate	---	Aluminum	3.2
Hardness, in terms of calcium carbonate	23	Copper	Less than 0.1
Total dissolved solids	1,210	Cadmium	Less than 0.01
		Lead	Less than 0.05
		Manganese	Less than 0.05
Ammonia	0.4		
Lithium	Less than 0.5	Silver	Less than 0.01
Barium	Less than 1.0	Zinc	Less than 0.5
Hexavalent chromium	Less than 0.01	Mercury	Less than 0.01
Arsenic	Less than 0.01		
Selenium	Less than 0.01		
Boron	0.4	pH	8.7
Hydroxide	Less than 0.1	Specific conductance	1,640 micromhos per cc

MEMBERS OF:

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AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N. OF OFFICIAL RACING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Vicks
CHEMIST

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THE INDUSTRIAL LABORATORIES COMPANY

Analytical and Consulting Chemists

2600 WEST 29TH AVENUE
DENVER, COLORADO 80211
ANALYSIS REPORT

TELEPHONE 455-3641

ATLANTIC RICHFIELD COMPANY

DATE RECEIVED: 10/17/74
DATE REPORTED: 11/4/74

LAB. NUMBER: 3709

SAMPLE MARKED: Sorghum Gulch #19 TO 981 Feet

SAMPLES ARE DISCARDED IN 15 DAYS FROM DATE OF REPORT UNLESS WE ARE REQUESTED, IN WRITING, TO RETAIN THEM FOR A LONGER PERIOD. PERISHABLE SAMPLES ARE USUALLY DISCARDED IMMEDIATELY UNLESS CLIENT HAS REQUESTED SPECIAL HANDLING (FREEZING, ETC.) IN ADVANCE.

ANALYSIS:

	MILLIGRAMS PER LITER		MILLI-EQUIVALENTS
Calcium	11		0.549
Magnesium	Less than 0.1		----
Sodium	762	Σ cations =	33.70
Carbonate	70	Σ anions =	31.72
Bicarbonate	1,760	% Diff =	3.0
Chloride	Less than 0.1		----
Sulfate	Less than 4.0		----
Nitrate	Less than 0.1		----
Phosphate	Less than 0.1		----
Silicon dioxide	8.4		0.280
Iron	Less than 0.5		----
Fluoride	10		0.523
P. alkalinity, in terms of calcium carbonate	--		
NO alkalinity, in terms of calcium carbonate	--		
Hardness, in terms of calcium carbonate	28		
Total dissolved solids	1,720		
Ammonia	0.7		
Lithium	Less than 0.5		
Barium	Less than 1.0		
Hexavalent chromium	Less than 0.01		
Arsenic	0.01		
Selenium	Less than 0.01		
Boron	0.4		
Hydroxide	Less than 0.1		
		Aluminum	Less than 0.05
		Copper	Less than 0.0
		Cadmium	Less than 0.01
		Lead	Less than 0.05
		Manganese	Less than 0.05
		Silver	Less than 0.01
		Zinc	Less than 0.5
		Mercury	Less than 0.01
		pH	8.6
		Specific conductance	2,350 micromhos per cc.

MEMBERS OF:

AMERICAN ASS'N OF CEREAL CHEMISTS
AMERICAN CHEMICAL SOCIETY
AMERICAN OIL CHEMISTS' SOCIETY
ASS'N OF OFFICIAL BAKING CHEMISTS
BAKERY ENGINEERS OF AMERICA
INSTITUTE OF FOOD TECHNOLOGY
SIGMA XI

THE INDUSTRIAL LABORATORIES COMPANY

H. Paul Wells
CHEMIST

THIS REPORT IS NOT TO BE REPRODUCED, IN WHOLE OR IN PART, FOR ADVERTISING PURPOSES WITHOUT OBTAINING PRIOR WRITTEN AUTHORIZATION

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 220 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434



Reply to
Instrumental Analysis Division
14335 West 44th Avenue
Golden, Colorado 80401

Phone: 303-278-9521

12 November 74

Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401

Re: IAD #97-140-002-33

ANALYTICAL REPORT

Samples	TOC* mg/liter	Nitrate** mg/liter N	Free Ammonia** mg/liter N
ARCO et.al. SG #18 c-b @ 1380'	3	0.26	0.017
ARCO et.al. SG #18 960' Top of para Cr. 800 mΩ	3	<0.04	0.013
✓ ARCO et.al. Wtr. samples SG #19 Top of para Cr. @ 466'	4	0.28	0.012
✓ ARCO SG #19 @ 860'	4	0.21	0.018
✓ ARCO SG #19 TD @ 981'	3	0.34	0.040
SG #9 Top of Mining Zone 1285'	3	3.35	0.025
SG #18 Base of Mining Zone TD 1425.6 (800mΩ)	3	3.40	0.029
SG #9 Btm of Mining Zone @ 1360'	4	0.27	0.042
ARCO SG #9 Core Point @ 1200'	4	0.76	0.022
ARCO et.al. SG #9 @ 993' Top of parachute creek 800 mΩ	4	0.32	0.013



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Mr. Frank Haas
12 November 74
Page 2

- * Test performed on samples marked 'Regular'
- ** Test performed on samples marked 'Hg for N'

Charles R. Wilson
Charles R. Wilson, Analyst

M. L. Jacobs
Approved by:
M. L. Jacobs, Ph.D.
Divisional Manager

CRW/dh

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO et.al. wtr samples SG #19 Top of
para. cr. @ 466'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.002
Thorium		Gadolinium		Molybdenum	0.01	Titanium	0.07
Bismuth		Europium		Niobium		Scandium	
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.2	Chlorine	*
Gold		Cerium	0.006	Rubidium	0.009	Sulfur	*
Platinum		Lanthanum	0.004	Bromine	0.006	Phosphorus	0.1
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic		Aluminum	2
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.02	Fluorine	*
Hafnium		Tin		Copper	0.02	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.007	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.002	Carbon	NR
Thulium		Silver		Iron	0.7	Boron	0.01
Erbium		Palladium		Manganese	0.06	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	0.7
Dysprosium						Hydrogen	NR

NR — Not Reported

All elements not reported $<0.006 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

M. J. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 728-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #19 @ 860'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	0.003
Thorium		Gadolinium		Molybdenum	0.07	Titanium	0.2
Bismuth		Europium		Niobium		Scandium	
Lead	0.03	Samarium		Zirconium		Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.4	Chlorine	*
Gold		Cerium		Rubidium	0.01	Sulfur	*
Platinum		Lanthanum	0.005	Bromine	0.007	Phosphorus	0.2
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	0.7
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.03	Fluorine	*
Hafnium		Tin		Copper	0.03	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.02	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.003	Carbon	NR
Thulium		Silver		Iron	0.9	Boron	***0.3
Erbium		Palladium		Manganese	0.02	Beryllium	
Holmium		Rhodium		Chromium	0.005	Lithium	1
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported $< 0.008 \mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

*** Heterogeneous

Approved:

M. Jacobs

COMMERCIAL TESTING & ENGINEERING CO.

GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 * AREA CODE 312 720-8434
INSTRUMENTAL ANALYSIS DIVISION, 14335 WEST AVENUE, GOLDEN, COLORADO, 80401, PHONE: 303-278-9521

Reply to

To: Mr. Frank Haas
The Oil Shale Corporation
18200 West Hiway 72
Golden, Colorado 80401



Date: 8 November 74

Analyst: S. Sweeney

P. O. No.:

Sample No.: ARCO SG #19 TD @981'

IAD No.: 97-140-002-33

CONCENTRATION IN $\mu\text{g/ml}$

ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.	ELEMENT	CONC.
Uranium		Terbium		Ruthenium		Vanadium	< 0.001
Thorium		Gadolinium		Molybdenum	0.009	Titanium	0.05
Bismuth		Europium		Niobium		Scandium	<0.001
Lead	0.01	Samarium		Zirconium	0.003	Calcium	*
Thallium		Neodymium		Yttrium		Potassium	*
Mercury	**0.0001	Praseodymium		Strontium	0.3	Chlorine	*
Gold		Cerium	0.001	Rubidium	0.005	Sulfur	*
Platinum		Lanthanum	0.001	Bromine	0.007	Phosphorus	0.02
Iridium		Barium	0.2	Selenium		Silicon	*
Osmium		Cesium		Arsenic	0.005	Aluminum	0.09
Rhenium		Iodine		Germanium		Magnesium	*
Tungsten		Tellurium		Gallium		Sodium	*
Tantalum		Antimony		Zinc	0.006	Fluorine	*
Hafnium		Tin		Copper	0.01	Oxygen	NR
Lutetium		Indium	STD	Nickel	0.01	Nitrogen	NR
Ytterbium		Cadmium		Cobalt	0.005	Carbon	NR
Thulium		Silver		Iron	0.2	Boron	0.04
Erbium		Palladium		Manganese	0.002	Beryllium	
Holmium		Rhodium		Chromium	0.002	Lithium	0.7
Dysprosium						Hydrogen	NR

NR - Not Reported

All elements not reported <0.002 $\mu\text{g/ml}$

* Not reported upon request

** Flameless Atomic Absorption

Approved:

M. J. Jacobs

HAZEN RESEARCH, INC.
4601 Indiana Street
Golden, Colorado 80401

Mr. Frank Haas
The Oil Shale Corporation

Date: November 27, 1974
HRI Project No. 535
HRI Series No. 7515
Samples received: Oct. 22, 1974

REPORT OF ANALYSIS

Page 2

Analysis No.	Sample Description	pCi/l		pCi/l		pCi/l	
		α	α	β	β	α	β
		Total \pm	Precision*	Total \pm	Precision*	Total \pm	Precision*
7515-21	9 Bottom-1360'	1.5 \pm	2.7	0	15		
-22	Top of parachute 9 Creek-993'	3.4 \pm	2.1	0	13		
-23	Top of mining zone 9-1285'	5.7 \pm	2.7	0	14	0.9 \pm	0.6
-24	A-10 67'	2.3 \pm	2.5	0	14		
-25	A-11 66'	2.2 \pm	2.6	0	14		
-26	A-11 66'	5.0 \pm	3.2	0	15	0	0.3
-27	A-12 78'	1.6 \pm	2.4	0	14		
-28	18-Base 1425.6'	4.0 \pm	2.2	0	13		
-29	18-1380'	1.8 \pm	1.9	0	13		
-30	Top of para. 18-960'	0.6 \pm	1.7	0	13		
-31 ✓	Top of para. 19-466'	2.8 \pm	2.1	0	13		
-32 ✓	19-860'	0.7 \pm	2.6	0	15		
-33 ✓	19-TD-981'	0 \pm	3.4	0	33		

*Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96 σ

By: John C. Jarvis
John C. Jarvis
Manager, Analytical Laboratory

ljb

BASELINE WATER QUALITY

A ground water quality sample taken during drilling is simply the first sample taken at that particular depth for that particular hole; the drilling samples primarily reflect changes in water quality versus DEPTH as we first enter the hole. Superimposed upon these drilling sampling requirements are the requirements of baseline monitoring, or measuring the fluctuations in water quality versus TIME. In many cases the initial water quality samples taken during drilling to study depth variation will also be used as the first samples in the baseline monitoring study of time variation. In a few cases we have taken special samples immediately after the cessation of drilling and completion of the hole to start our baseline monitoring.

Water quality data from samples taken during drilling are reported in the previous section. Of the samples collected after drilling and completion operations had ceased, only the analysis of SG-18a had been completed on November 30, 1974. That analysis is presented in this section.

TABLE II B-15

BASELINE WATER QUALITY ANALYSIS
MONITORING WELL

Well Number: 18a, at 1330' T.D.

Location: See fig. II B-1

DATE SAMPLE TAKEN		11/1/74			
Element Measured (+)					
1. Aluminum		0.5			
2. Ammonia					
3. Arsenic		.02			
4. Barium		.03			
5. Beryllium		<.007			
6. Bicarbonate		471			
7. Bismuth		<.007			
8. Boron		1.4			
9. Cadmium		<.007			
10. Calcium		24			
11. Carbonate		0			
12. Cerium		<.007			
13. Chloride		3			
14. Chrome, Hexavalent					
15. Cobalt		.001			
16. Conductivity, Specific					
17. Copper		.02			
18. Fluoride		190			
19. Gallium		<.007			
20. Hardness, Total					
21. Hydroxide					
22. Iron		0.02			
23. Lead		<.02			
24. Lithium		.3			
25. Magnesium		30			
26. Manganese		0.04			
27. Mercury		.0024			
28. Molybdenum		0.03			
29. Nickel		0.005			
30. Nitrate		0.22			
31. pH		8.2			
32. Phosphate, Total					
33. Potassium		0.4			
34. Selenium		<.007			
35. Silica		23			
(*) 36. Silver					
37. Sodium		135			
38. Solids, Dissolved		536			
39. Strontium		0.3			
40. Sulfate		84			
41. Titanium		0.04			
42. Vanadium		0.001			
43. Yttrium		0.007			
44. Zinc		0.03			
45. Zirconium		<.007			
46. Radioactivity					
Gross Alpha (pcl)		8.0			
Radium 226*		0.1			
Gross Beta (pcl)		0			
Thorium 230**					
Uranium**					
47. Total Organic Carbon (TOC)		<1			
If TOC > 10 mg/l then measure					
Dissolved Organic Carbon					
Suspended Organic Carbon					
Phenols					
Sulfate, Acid Extraction					
Nitrogen, Base Extraction					

(*) Not required

* Required if gross alpha is greater than 4 picocuries per liter (pcl).

** Required if gross beta is greater than 100 picocuries per liter (pcl).

(+) Unless otherwise stated, all units are mg/l.

GEOPHYSICAL LOG DATA

Only two types of geophysical logs are required to be run on test holes. They are the sonic log and resistivity log. As of September 12, 1974, the latter shall be either a standard electric resistivity log or focussed electric resistivity log rather than the induction-type log. Table II B-16 shows the individual geophysical logs completed as of November 30, 1974 on each well on Tract C-b.

Resistivity logs are used for the definition of formations, for correlations, and for qualitative and quantitative analysis of formations in terms of fluid saturation and porosity. Most wells have had a laterolog run to satisfy this requirement; the Birdwell standard electrical survey was run on AT-1a and SG-10.

Sonic logging fundamentally involves measuring the time required for a sound wave to travel through a definite length of formation. The sonic log is quite detailed and is a good log for correlation purposes. Birdwell velocity logs (sonic) were run on wells AT-1a and SG-10; on all other wells Schlumberger borehole compensated sonic log-gamma ray logs were run.

Logs run and not required are the gamma ray, neutron density, temperature, micro-seismograph, and caliper logs.

TABLE II B-16

GEOPHYSICAL LOGS

Geophysical Log Type	A.T.1	A.T.1a	A.T.1b	A.T.1d	S.G.10	S.G.11	S.G.18	S.G.19	Cb-1	Cb-2	Cb-3	Cb-4
Schlumberger:												
B-Borehole Compensated Sonic	X		X	X		X	X	X				
L-Laterolog	X		X	X		X	X	X				
FD-Formation Density	X		X	X								
ND-Neutron Formation Density	X		X	X								
T-Temperature	X	X	X	X	X	X	X	X				
CBL-Cement Bond Log				(X)		(X)				(X)		(X)
Birdwell:												
V-Velocity, 3-Dimensional		X			X							
E-Electric		X			X							
D-Density		X			X							
N-Nuclear		X			X							
C-Caliper		X			X				X	X	X	X
T'-Temperature		X			X							
Welex:												
W-Micro-Seismogram		(X)			(X)							
McCullough:												
TM-Temperature			(X)									

() - Field copies only of the geolog are available. Films are not complete for distribution.



Ti
Ma
Equi
Recon
Witnes

SWS-1363-E

Schlumberger

BOREHOLE COMPENSATED SONIC LOG - GAMMA RAY

COUNTY <u>RIO BLANCO</u> FIELD or LOCATION WELL <u>SORGUM GULCH</u> AQUIFER NO. <u>1</u> COMPANY <u>ATLANTIC RICHFIELD</u>	COMPANY <u>ATLANTIC RICHFIELD COMPANY</u>			
	WELL <u>SORGUM GULCH AQUIFER NO. 1</u>			
	FIELD _____			
	COUNTY <u>RIO BLANCO</u> STATE <u>COLORADO</u>			
LOCATION		Other Services:		
Sec. <u>7</u> Twp. <u>3S</u> Rge. <u>96W</u>		DIL TEMP. FDC-GR CNL-GR		
Permanent Datum: <u>GL</u> , Elev. <u>6909</u>		Elev.: K.B. <u>----</u>		
Log Measured From <u>GL</u> , <u>0</u> Ft. Above Perm. Datum		D.F. <u>----</u>		
Drilling Measured From <u>GL</u>		G.L. <u>6909</u>		
Date	<u>7-5-74</u>			
Run No.	<u>ONE</u>			
Depth—Driller	<u>1338</u>			
Depth—Logger	<u>1338</u>			
Btm. Log Interval	<u>1328</u>			
Top Log Interval	<u>410</u>			
Casing—Driller	<u>13-3/8 @166</u>	<u>@</u>	<u>@</u>	<u>@</u>
Casing—Logger	<u>----</u>			
Bit Size	<u>12-1/4</u>			
Type Fluid in Hole	<u>WATER</u>			
Dens.	Visc.			
pH	Fluid Loss	<u>ml</u>	<u>ml</u>	<u>ml</u>
Source of Sample				
R _m @ Meas. Temp.	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F
R _{mf} @ Meas. Temp.	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F
R _{mc} @ Meas. Temp.	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F
Source: R _{mf} R _{mc}				
R _m @ BHT	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F	<u>@</u> °F
Time Since Circ.				
Max. Rec. Temp.	<u>68</u> °F	<u>°F</u>	<u>°F</u>	<u>°F</u>
Equip. Location	<u>7674 VERNAL</u>			
Recorded By	<u>HAUGAARD</u>			
Witnessed By	<u>TATE</u>			

The well name, location and borehole reference data were furnished by the customer.

REMARKS

Scale Changes

Scale Down Hole

10

111

1000 JOURNAL OF CLIMATE

1000 JOURNAL OF CLIMATE

100

Other

2

(NIM)

1

18

•

10

10

API UNITS

INTERVAL TRANSIT TIME

MICROSECONDS PER FOOT

0

150

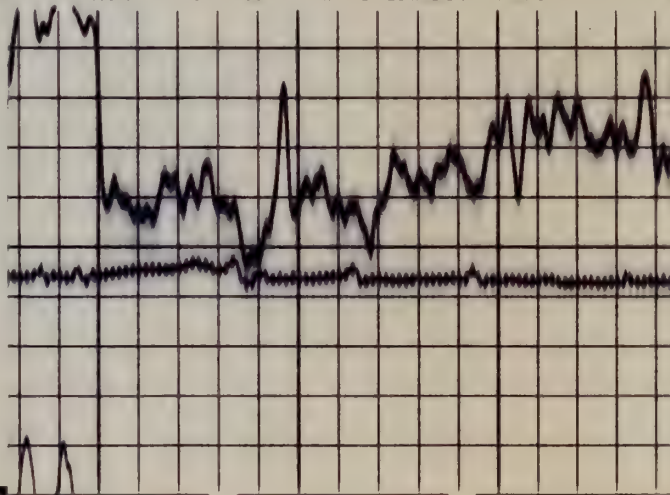
300

CALIPER

HOLE DIAM. IN INCHES

8

18



0400

0500

T 3 R₁ 2 R₂

140

240

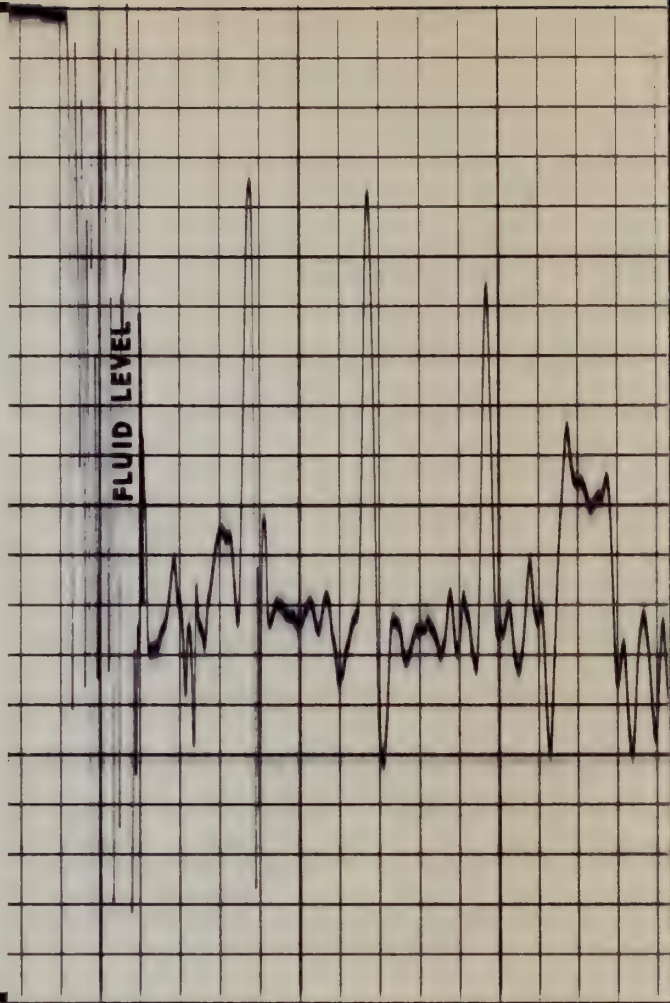
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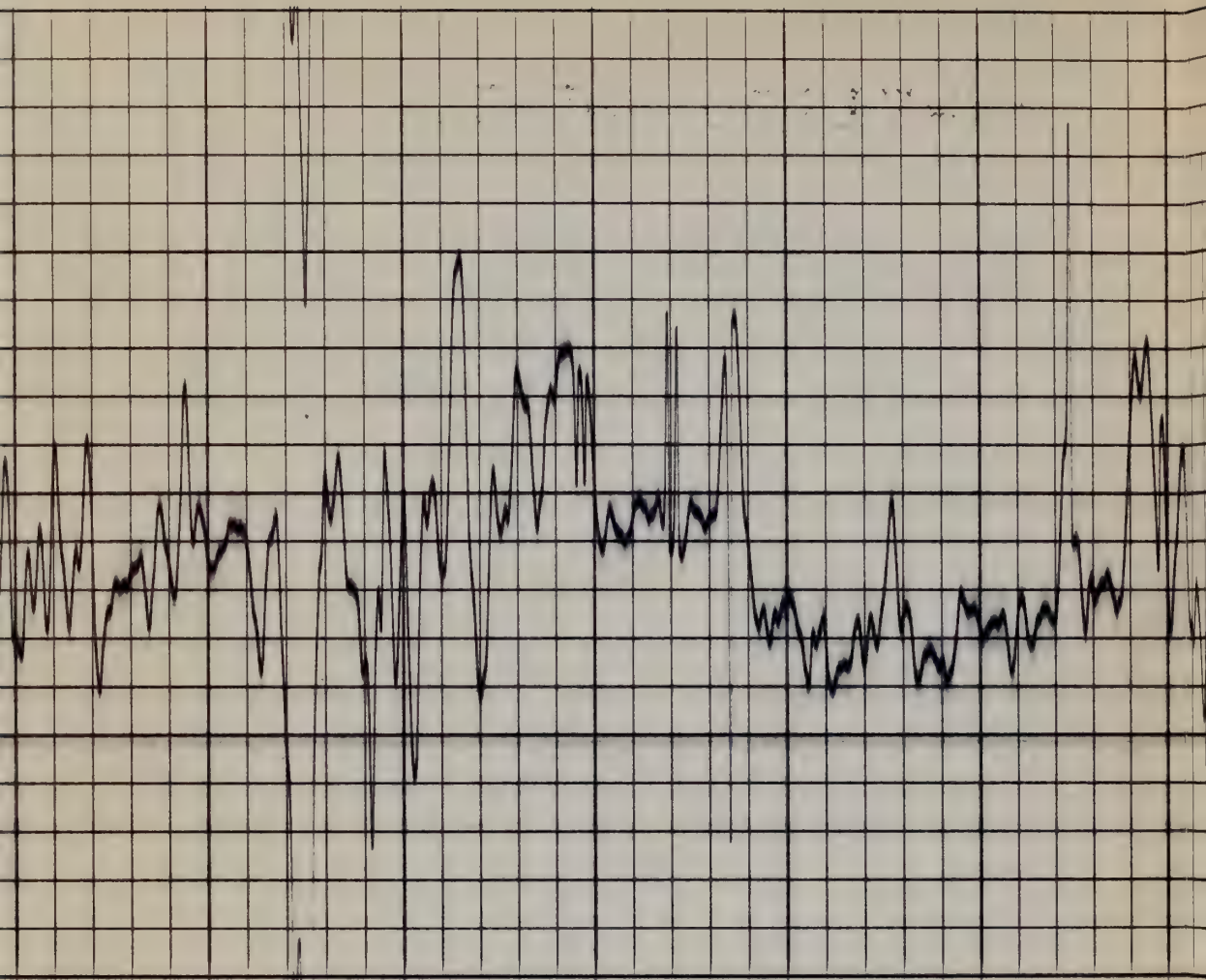
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40

140

FLUID LEVEL

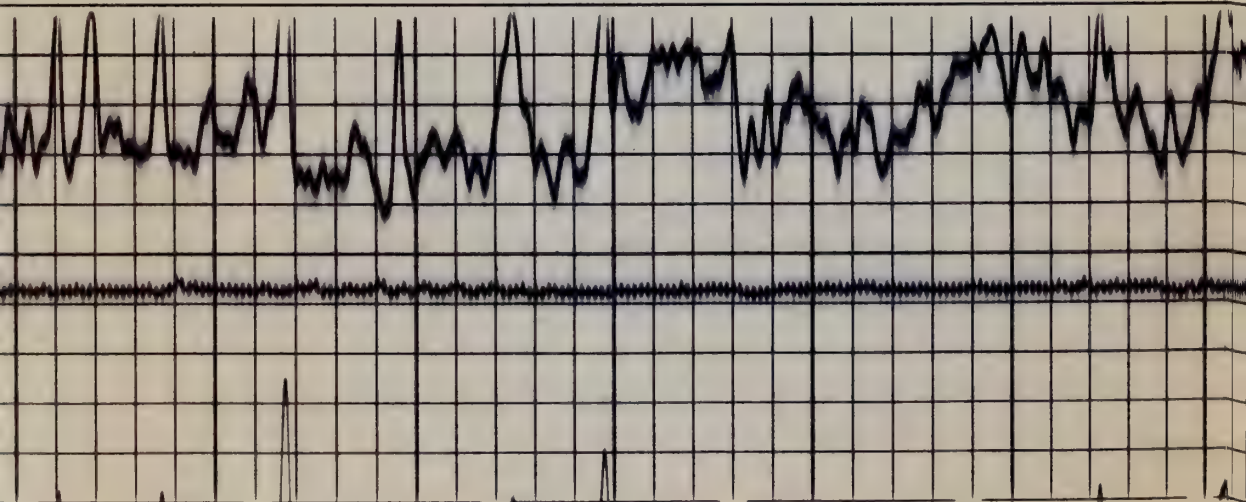


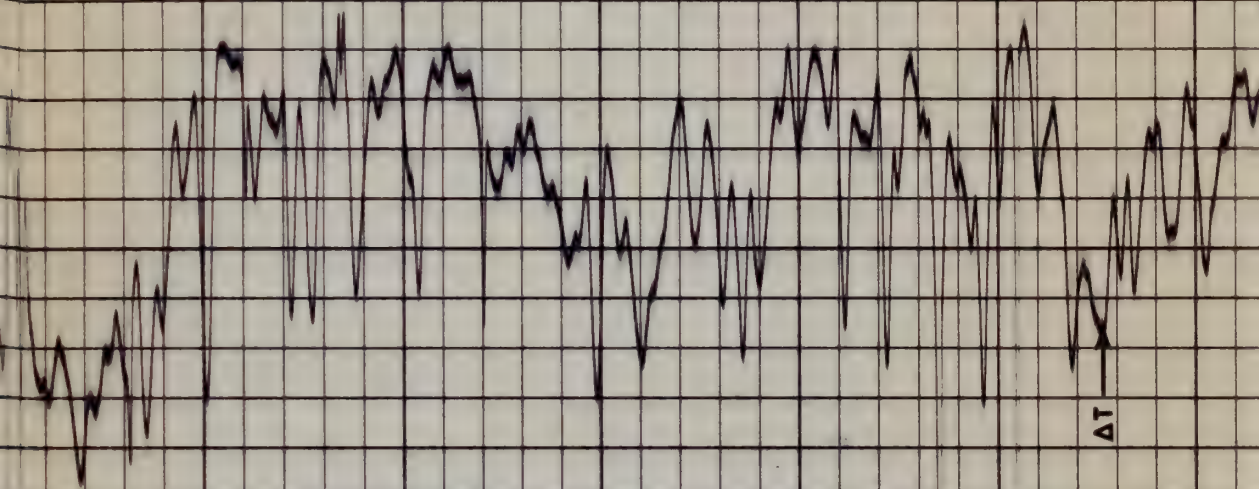


0600

0700

0800

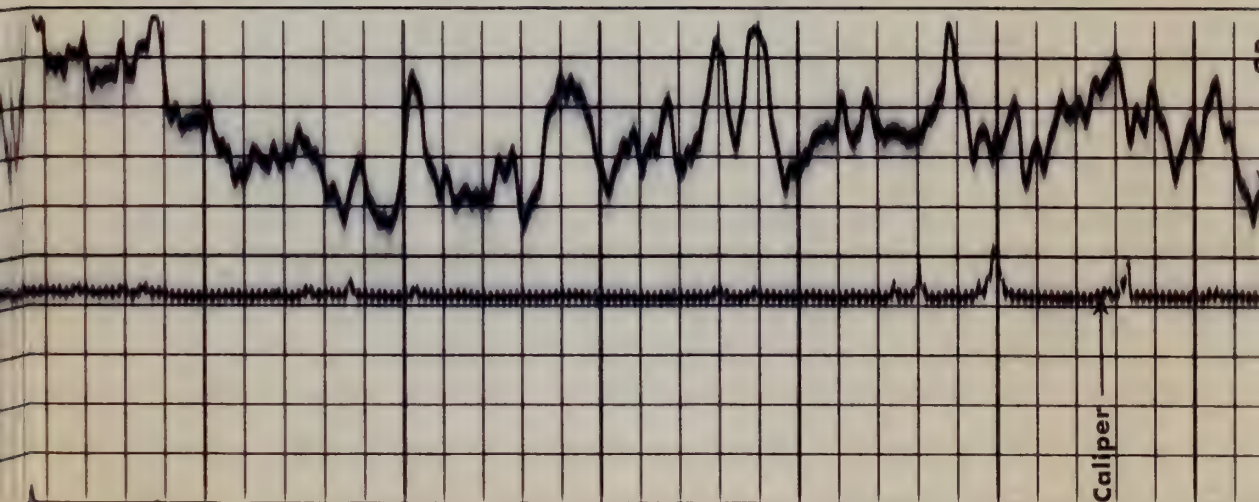


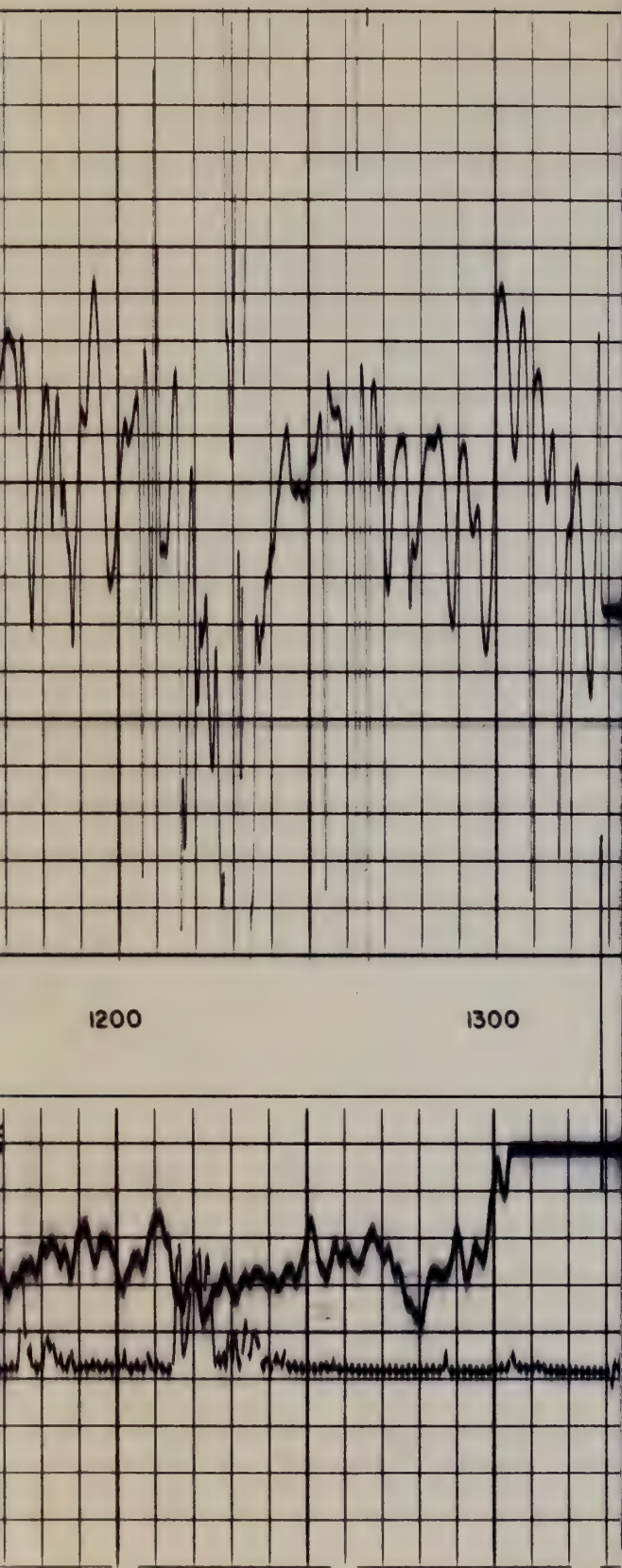


0900

1000

1100



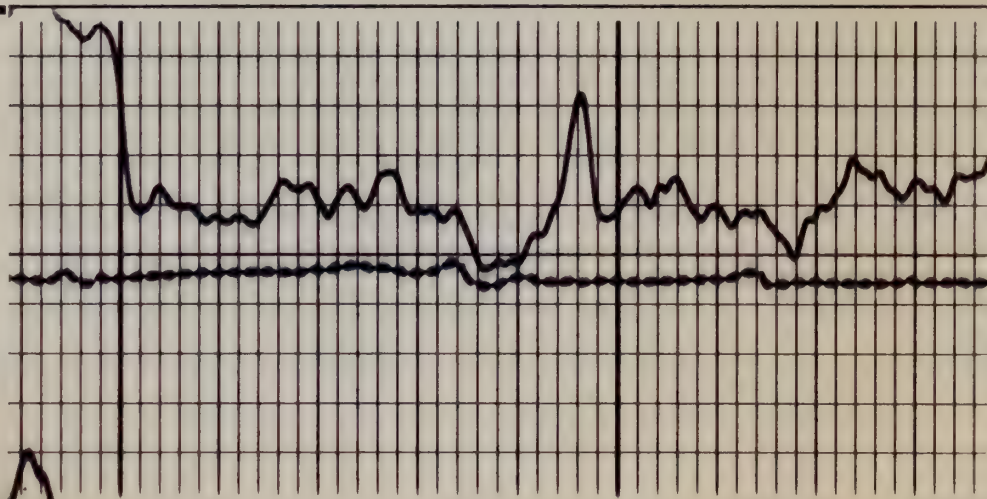


DETAIL LOG			
5"=100'			
GAMMA RAY API UNITS	DEPTHS	INTERVAL TRANSIT TIME MICROSECONDS PER FOOT	
0	150	$T \frac{3}{R_1} \frac{2}{R_2}$	
150	300	140 90 190 40 140	
CALIPER HOLE DIAM. IN INCHES			

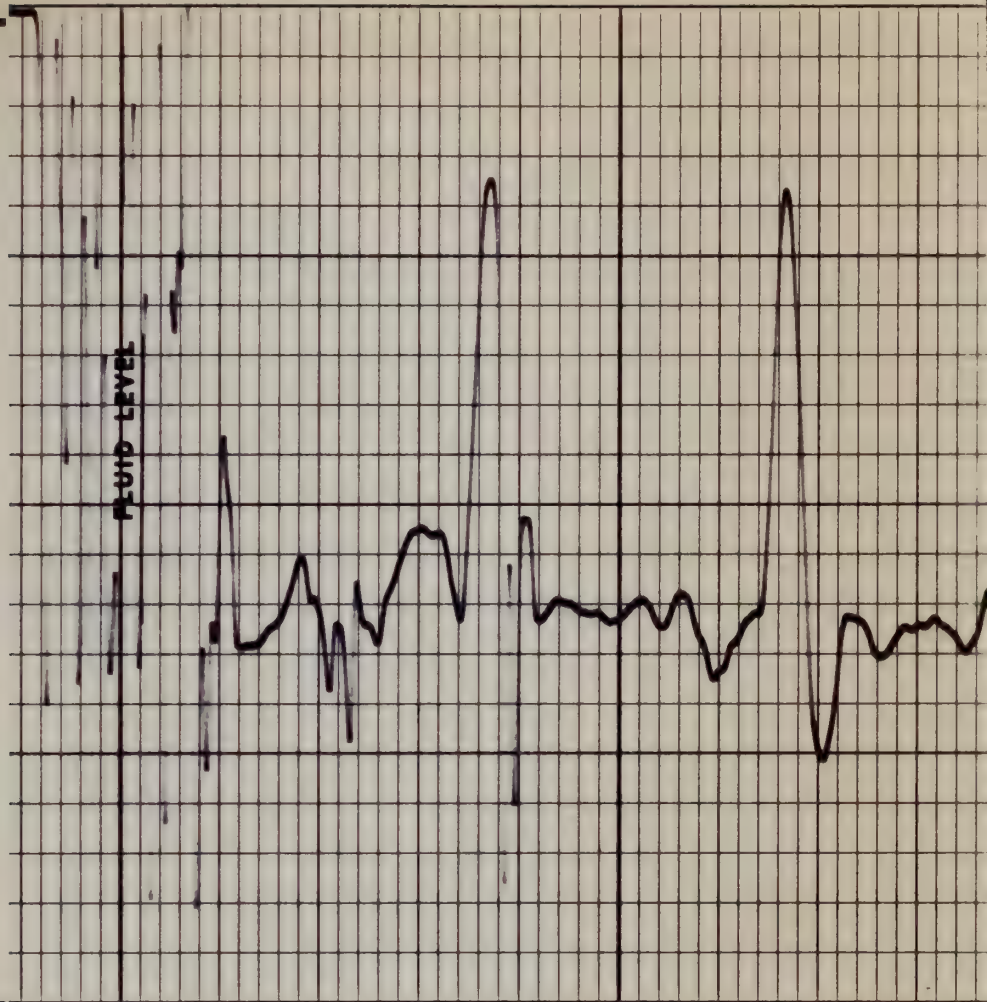
CALIPER
HOLE DIAM. IN INCHES

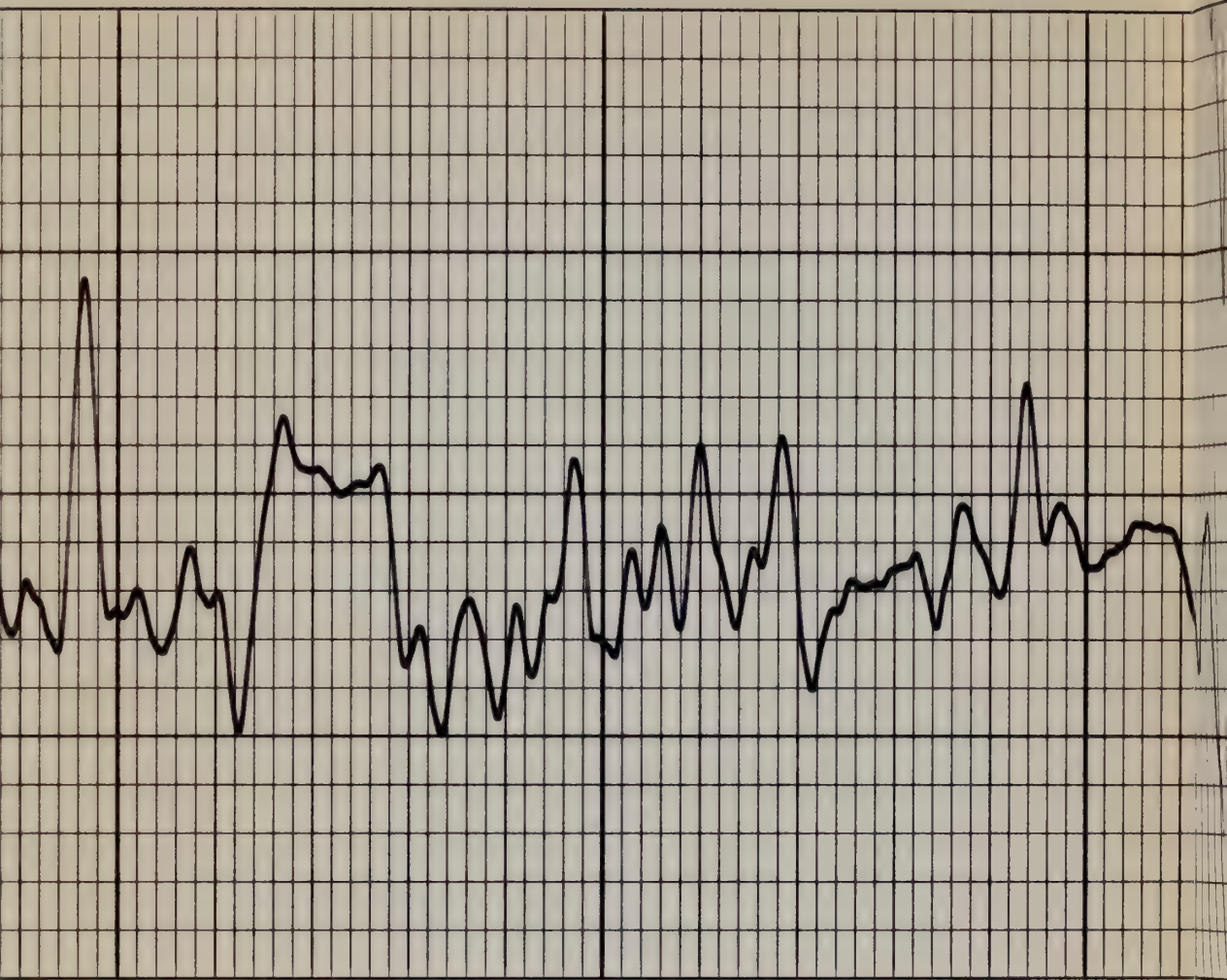
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8



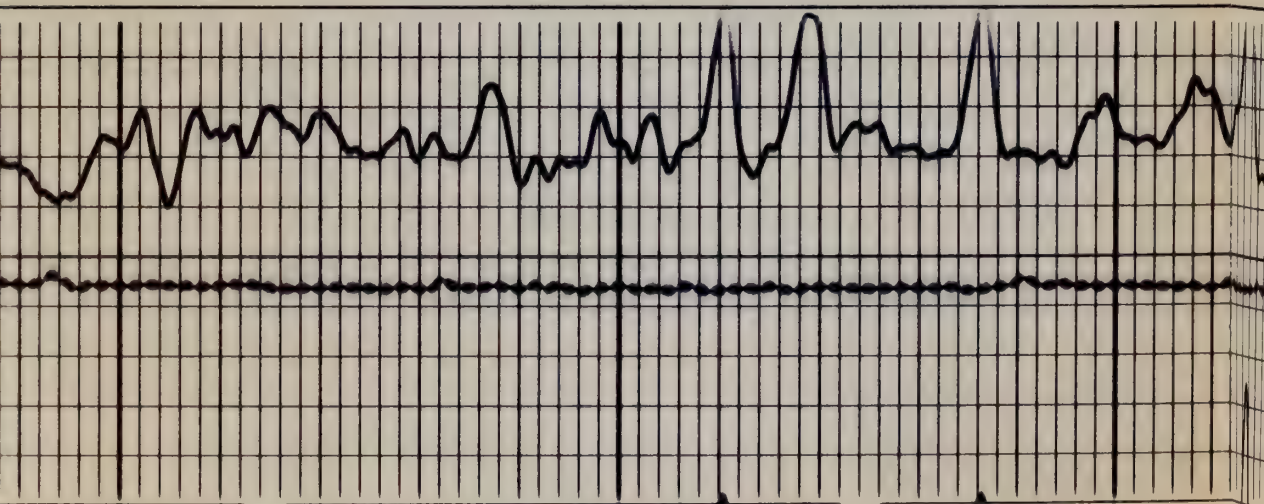
0400

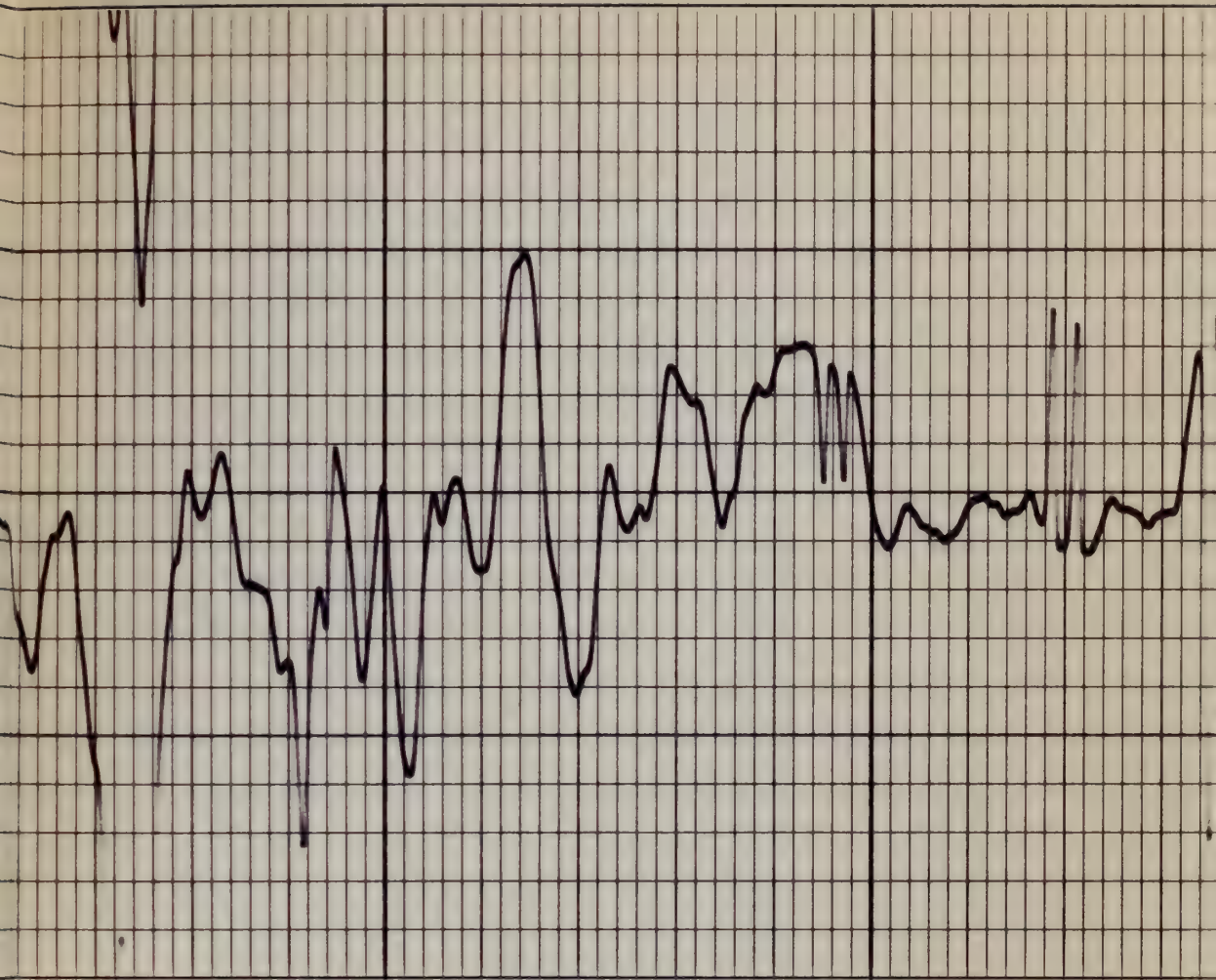




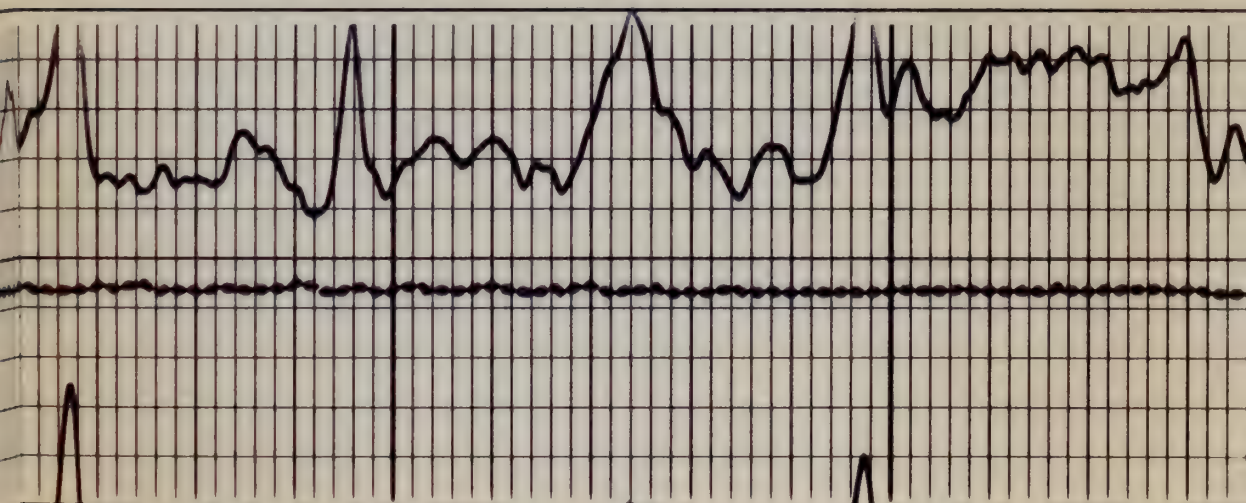
0500

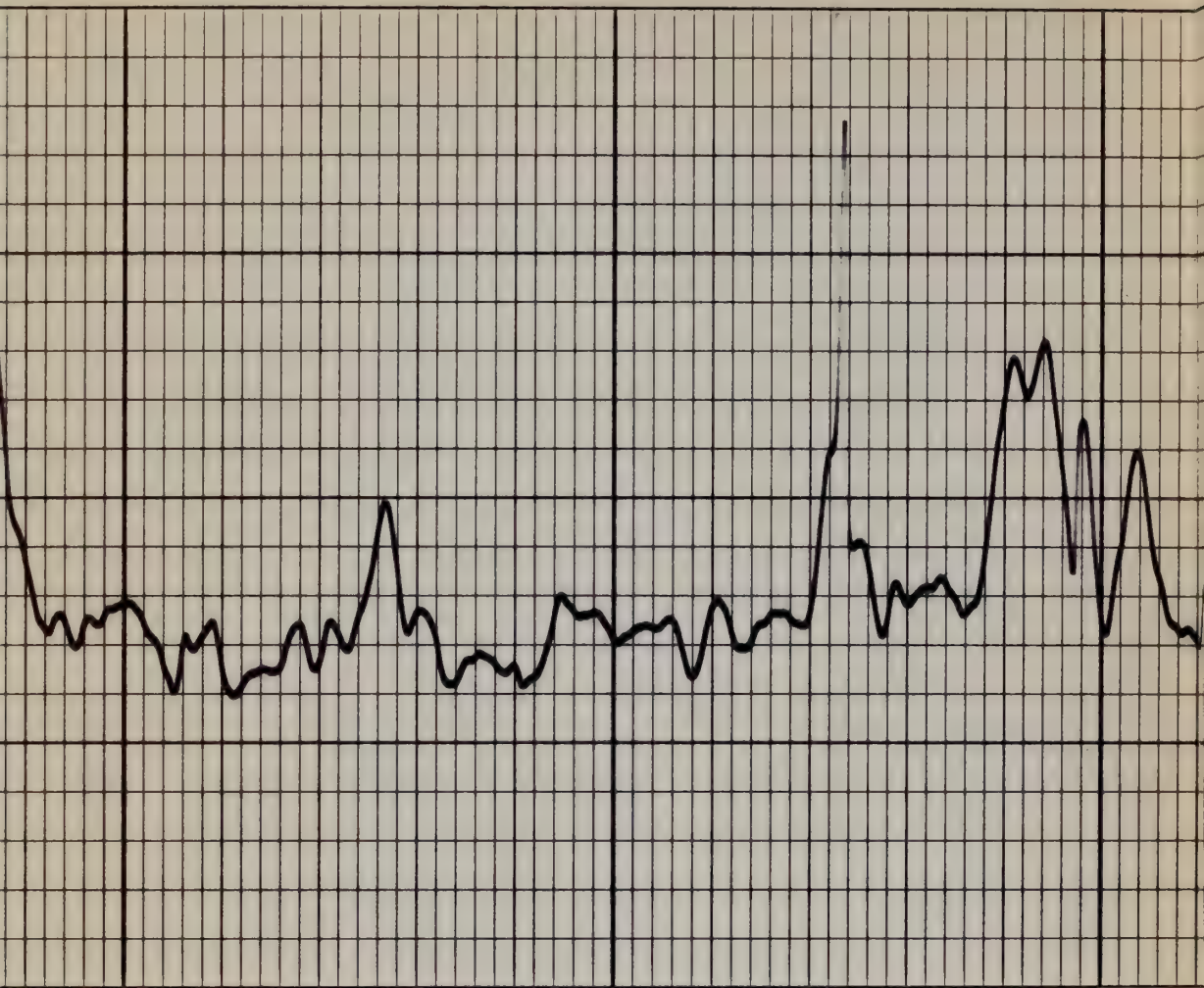
0600



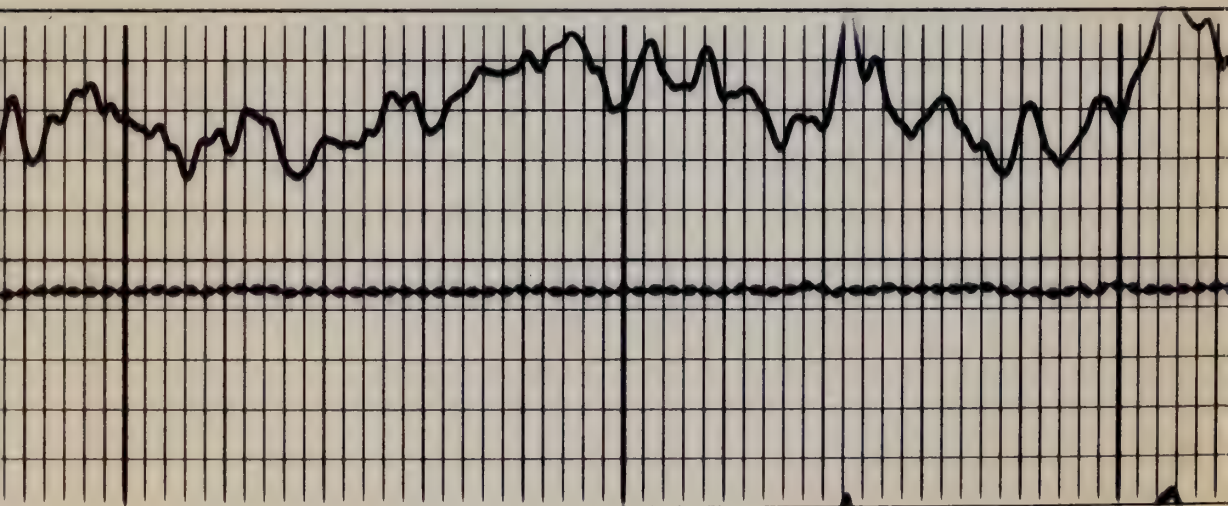


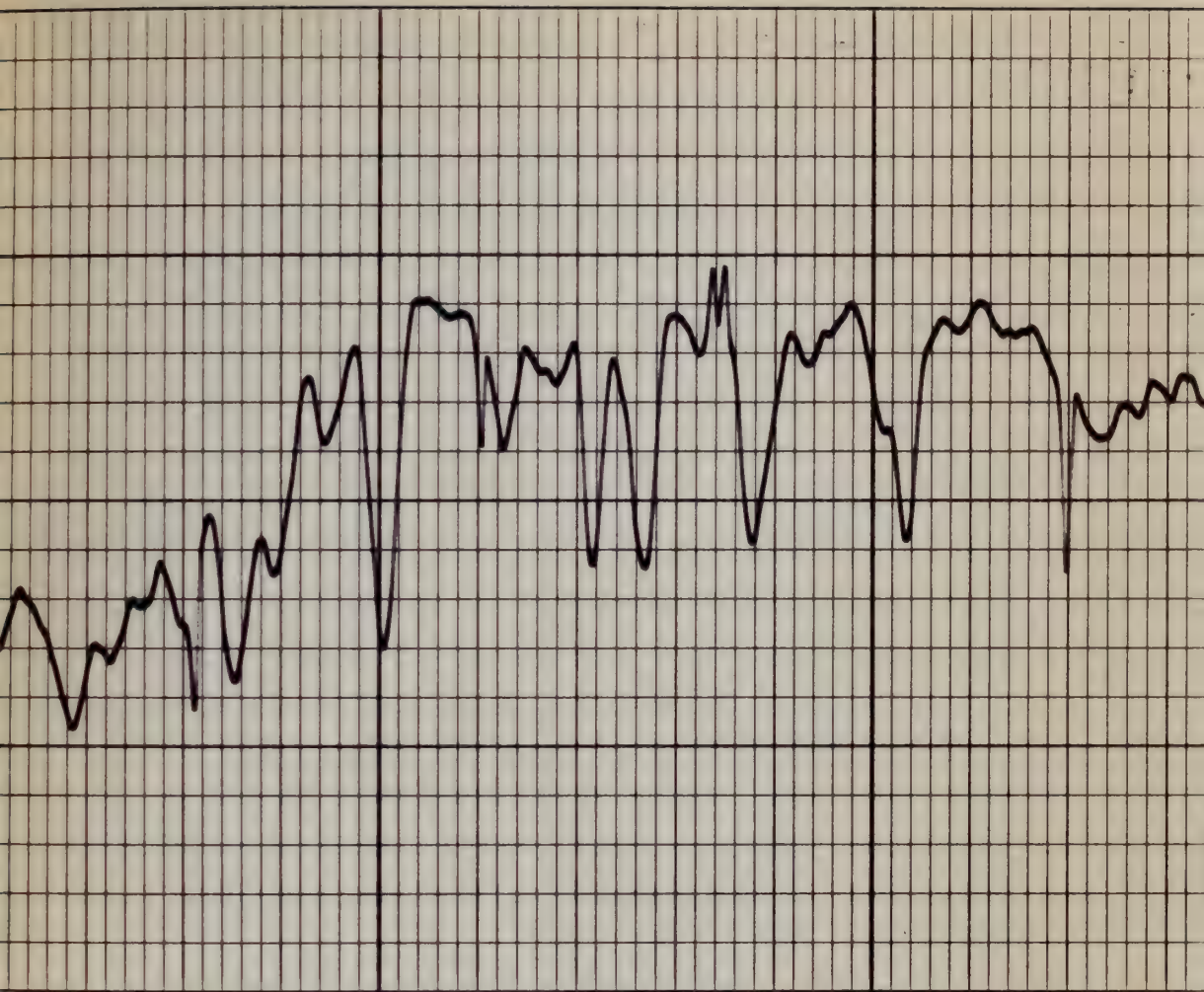
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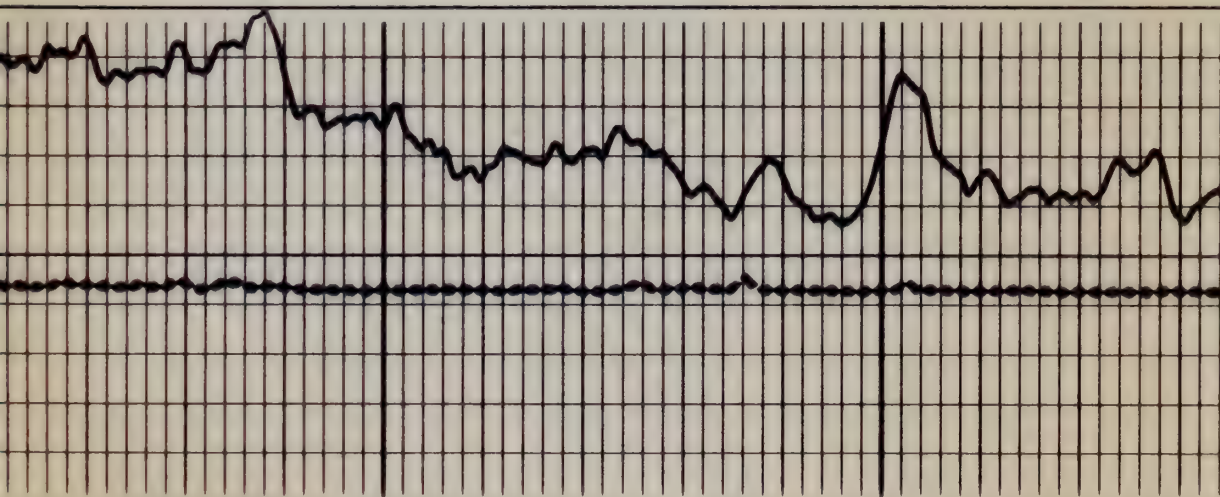


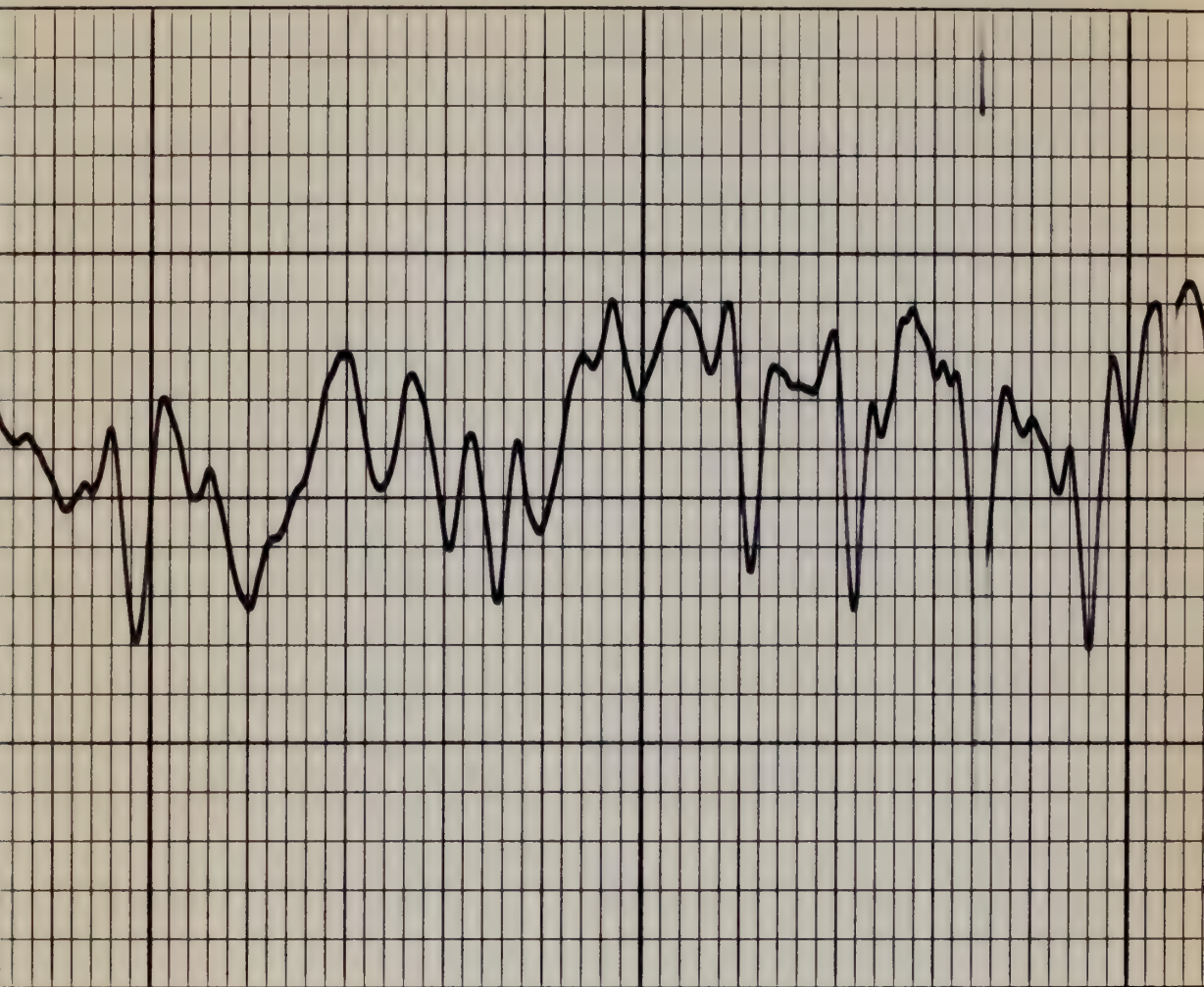
0800





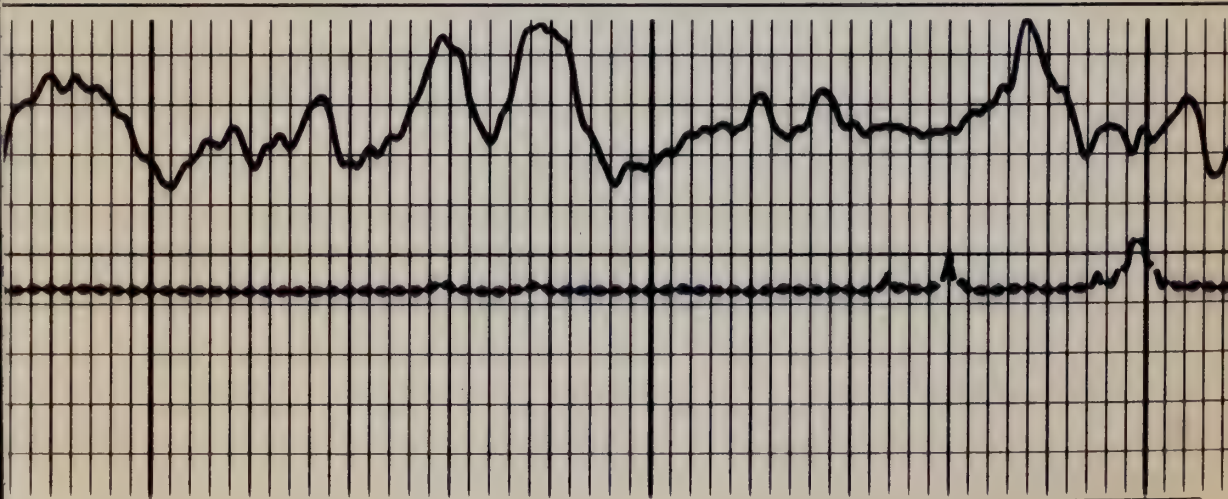
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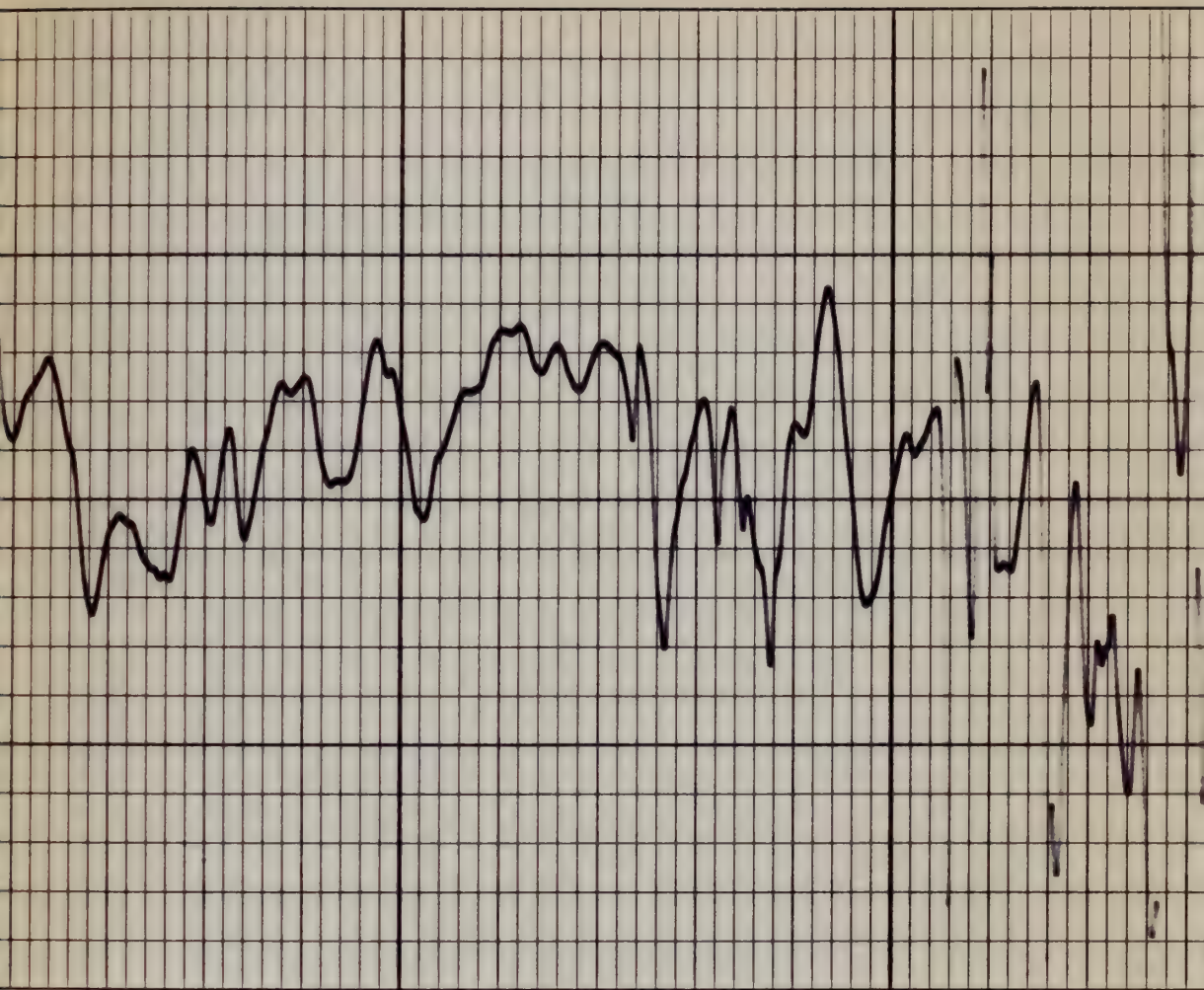




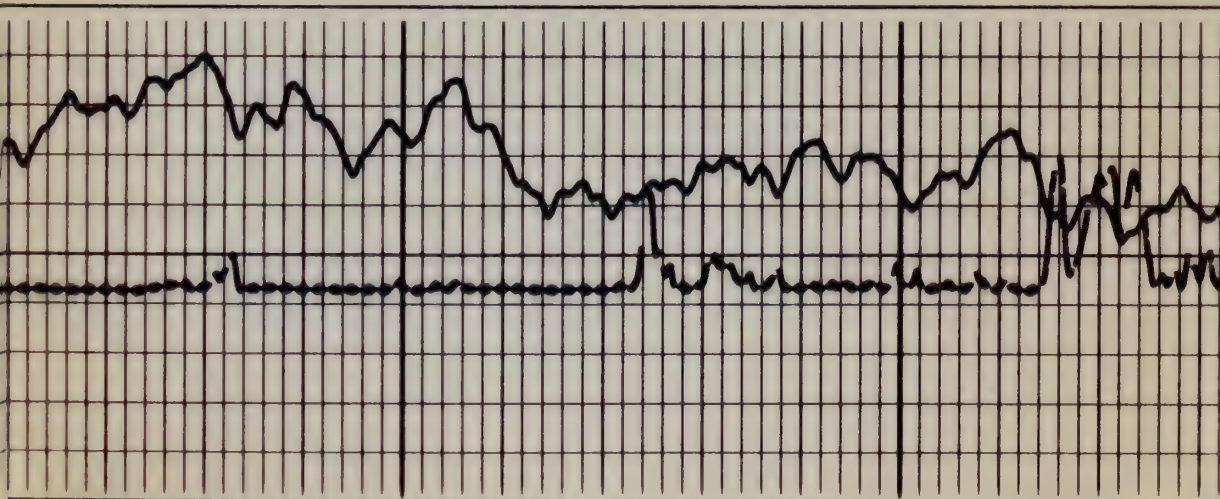
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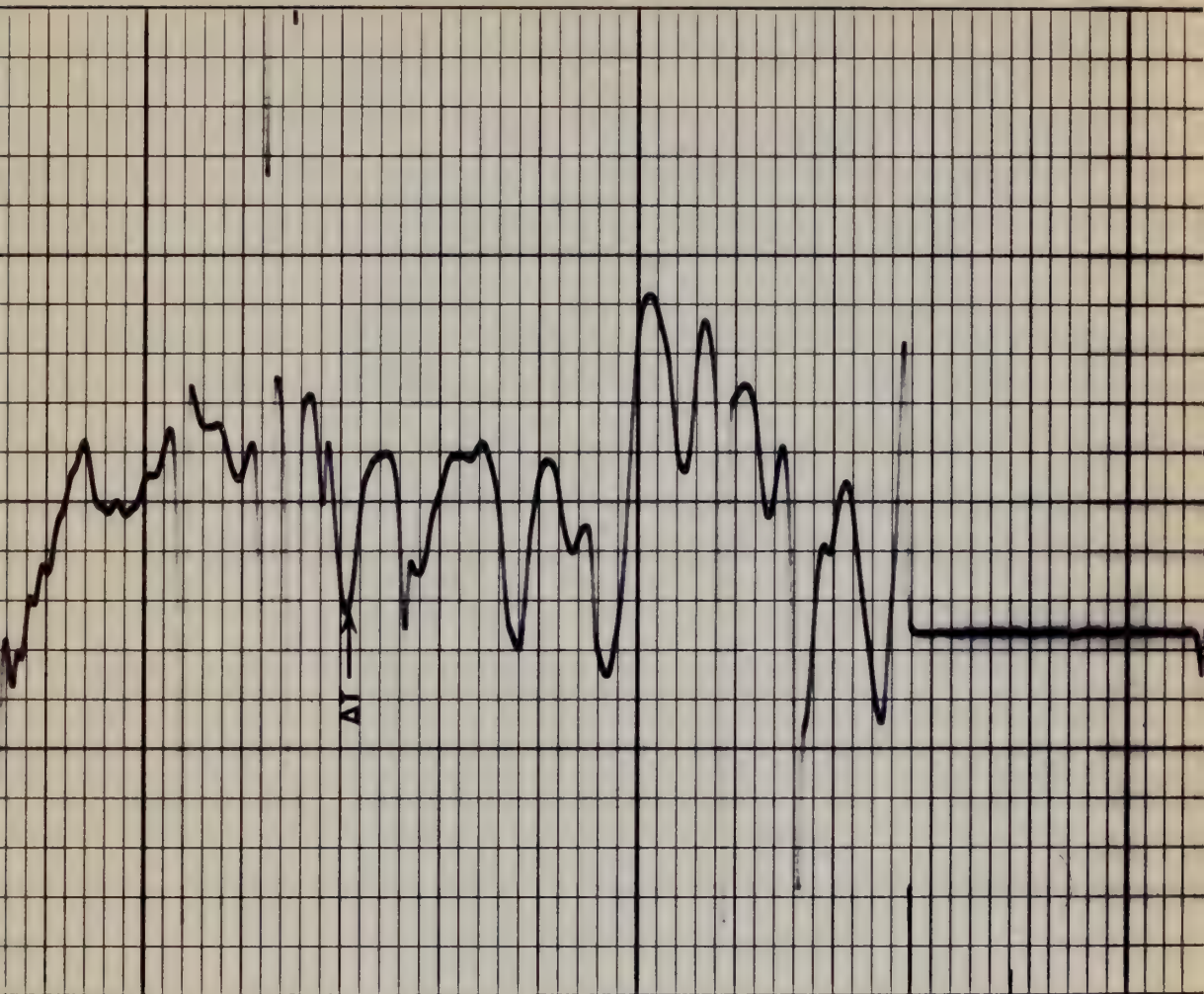
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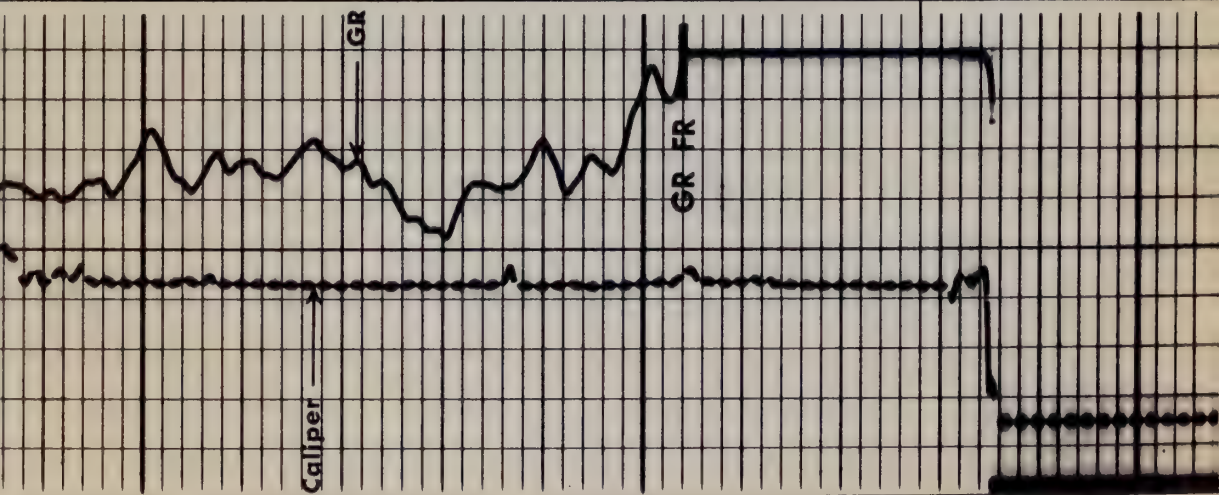


1200



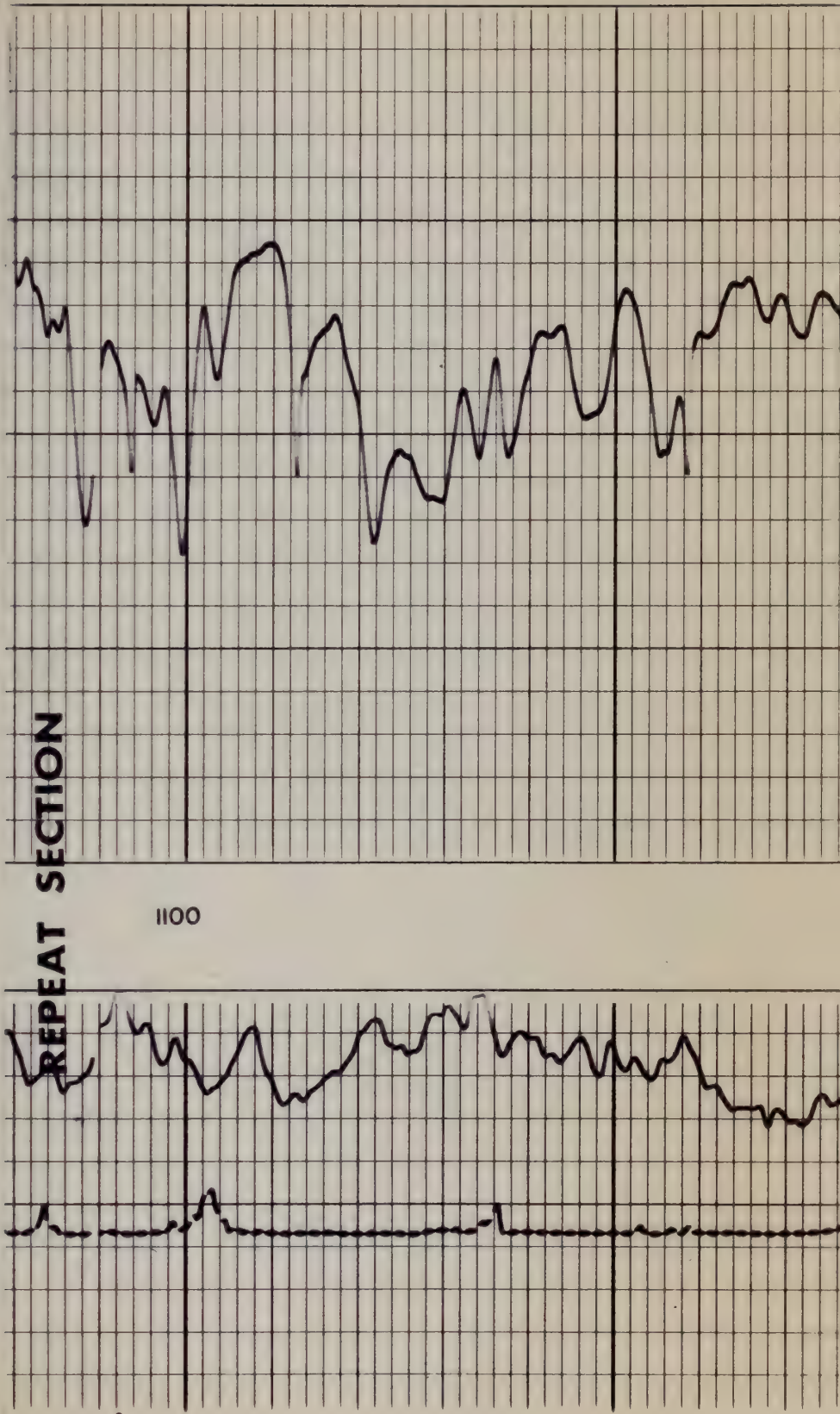


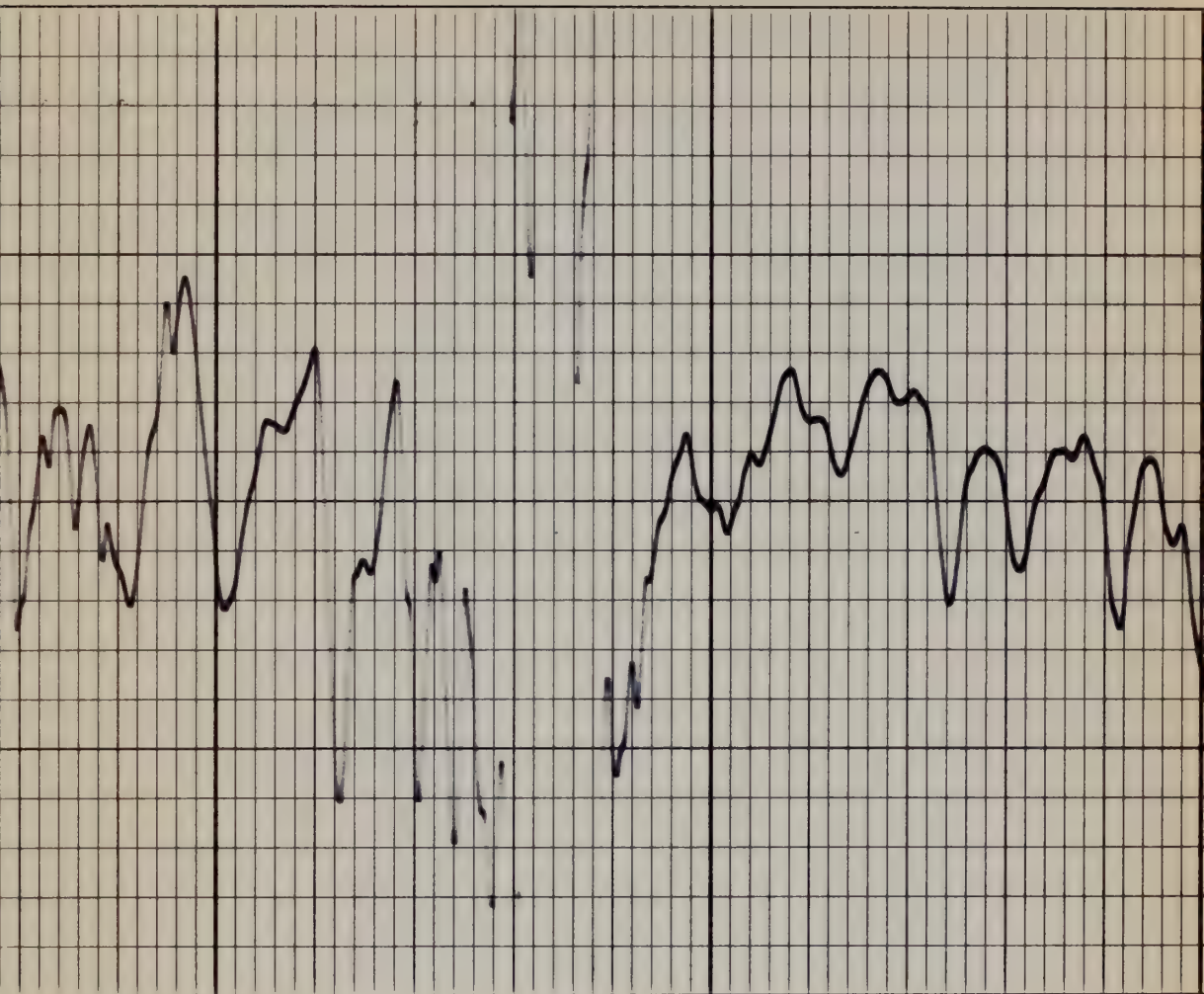
1300



REPEAT SECTION

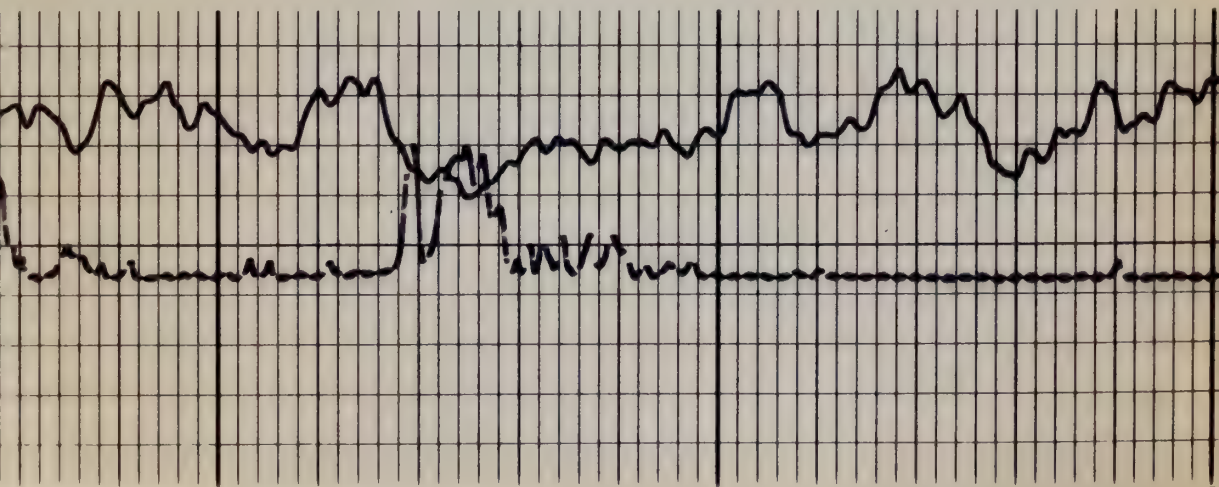
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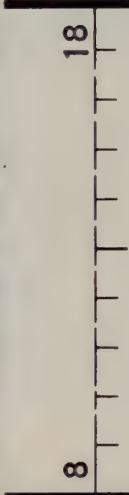
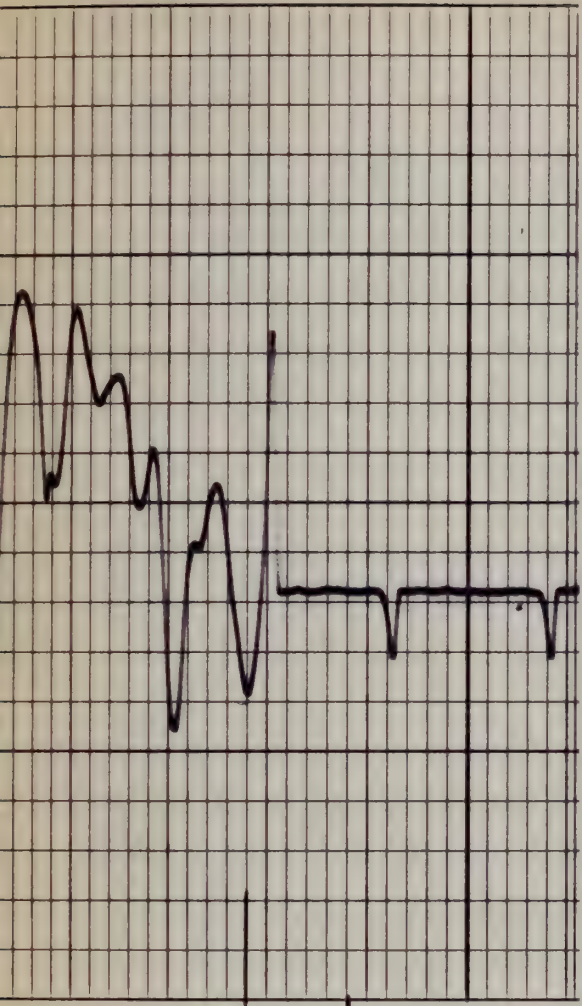




1200

130





CALIPER	
HOLE DIAM. IN INCHES	
0	150
150	300

T 3 R ₁ 2 R ₂		40
		140
		90
		190
		140
		240

CAMMA RAY

DE

INTERVAL TRANSIT TIME

INTERVAL TIME IN SECONDS

API UNITS MICROSECONDS PER FOOT

DEPTH

WELL NO.

API UNITS

COMPANY ATLANTIC RICHFIELD COMPANY

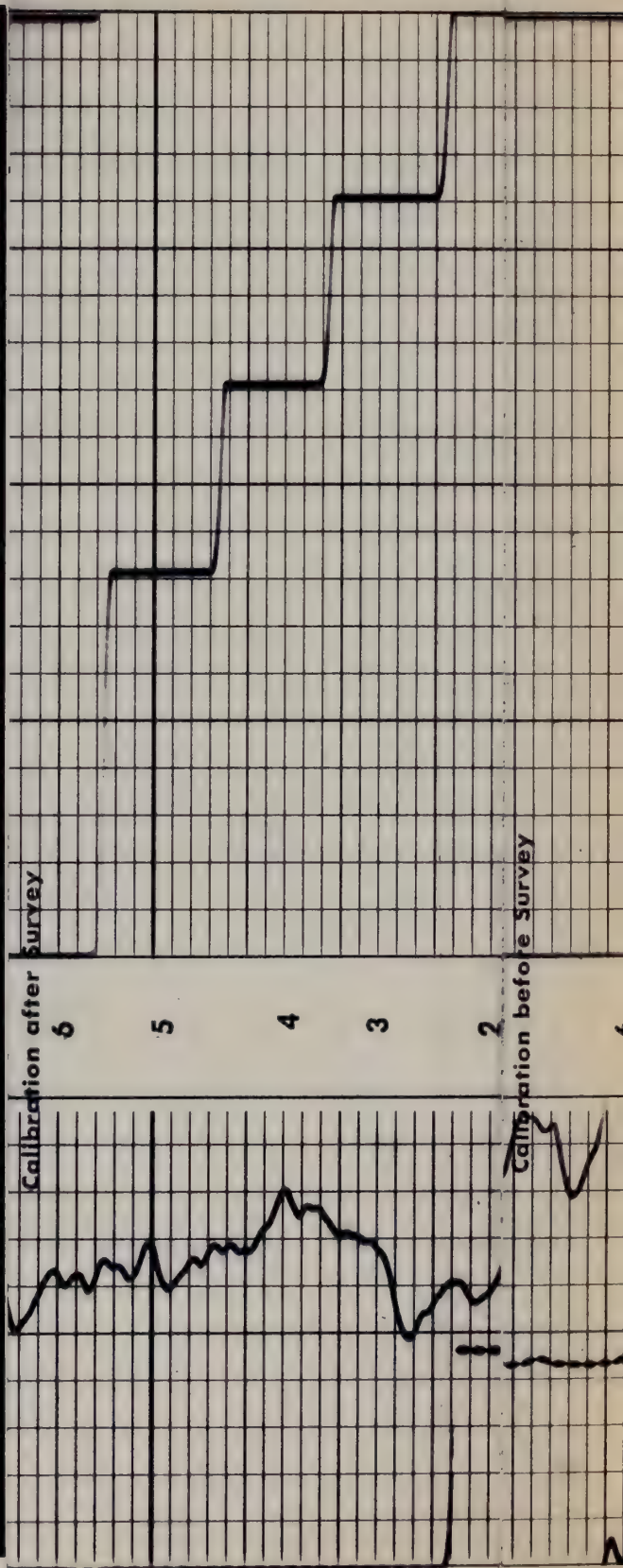
WELL SORGUM GULCH AQUIFER NO. 1

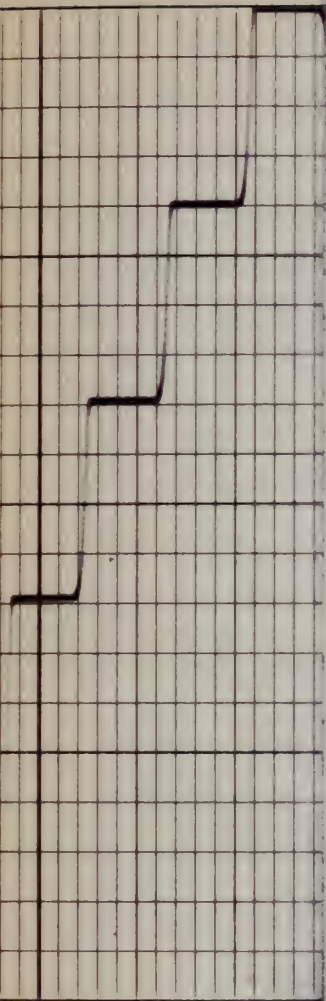
FIELD

COUNTY RIO BLANCO STATE COLORADO

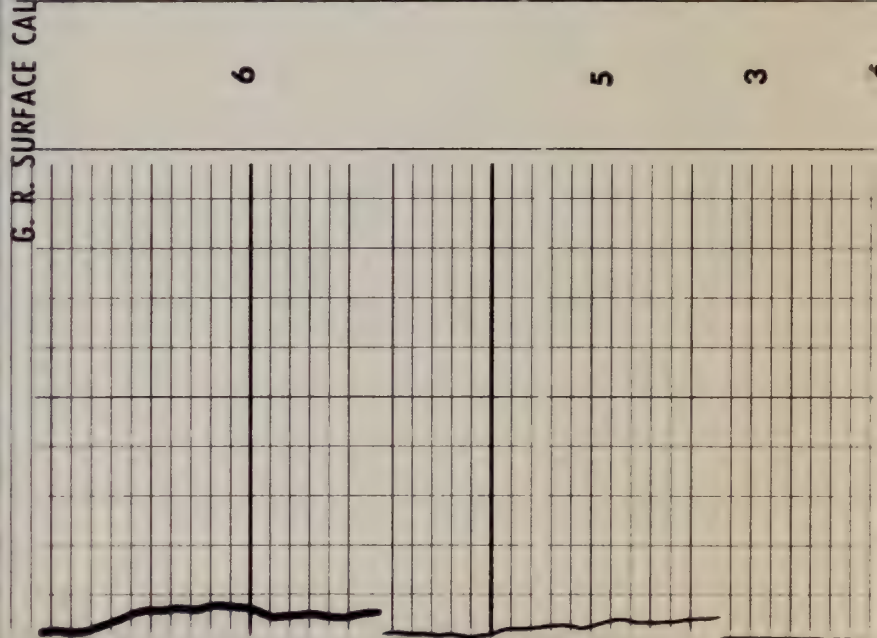
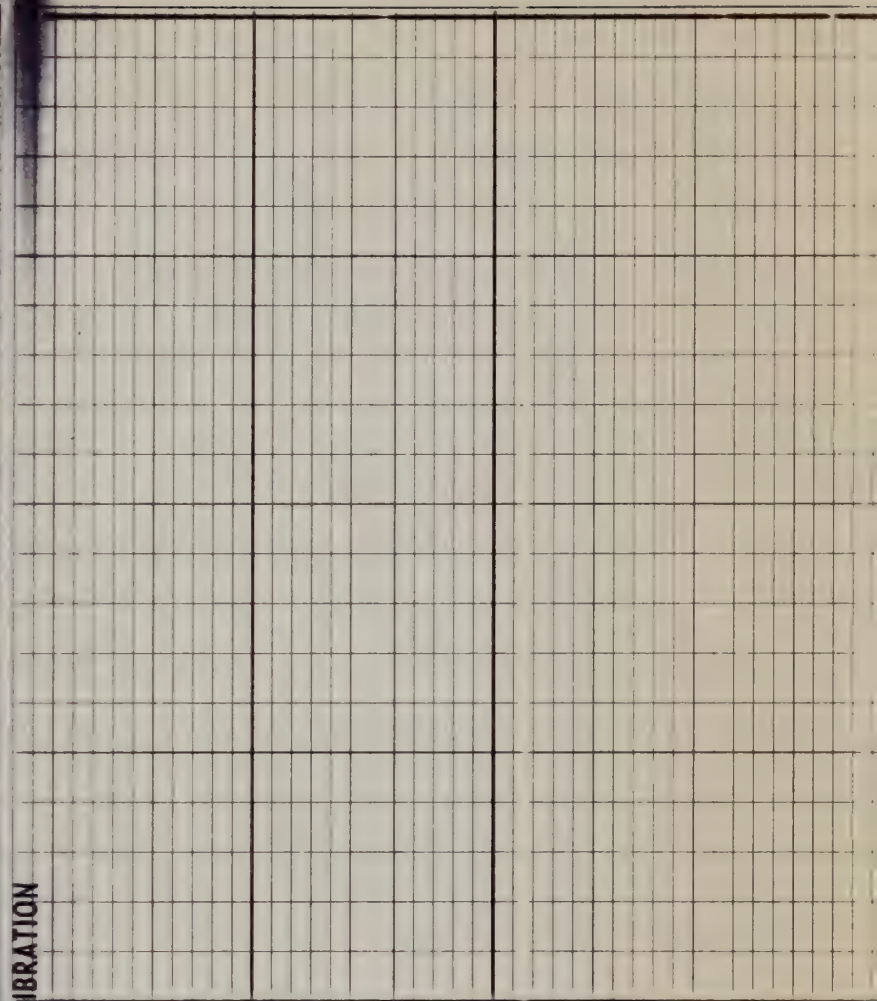
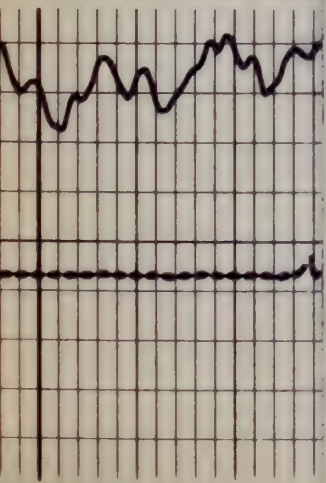
SCHL. FR 1328
SCHL. TD 1338
DRLR TD 1338
Elev: KB ---
DF ---
GL 6909

CALIBRATION DATA





G. R. SURFACE CALIBRATION



BOREHOLE COMPENSATED SONIC CALIBRATION CODING

- 1. MECHANICAL ZERO
- 2. 40 μ SEC/FT
- 3. 60 μ SEC/FT
- 4. 80 μ SEC/FT
- 5. 100 μ SEC/FT
- 6. 140 μ SEC/FT

GAMMA RAY CALIBRATION CODING

- 1. MECHANICAL ZERO
- 2. ELECTRICAL ZERO
- 3. RECORDER SENSITIVITY
- 4. MEMORIZER ADJUSTMENT
- 5. BACKGROUND
- 6. CALIBRATION



CALIBRATION DATA

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO.1

SCHL. FR 1328
SCHL. TD 1338
SCLP TO 1338

FIELD _____

COUNTY RIO BLANCO STATE COLORADO

Elev: KB ----
DF ----
GL 6909

Schlumberger

DUAL INDUCTION - LATEROLOG WITH LINEAR CORRELATION LOG

COUNTY **RIO BLANCO**
FIELD or LOCATION **SORGUM GULCH**
WELL **AQUIFER NO. 1**
COMPANY **ATLANTIC RICHFIELD**

COMPANY **ATLANTIC RICHFIELD COMPANY**

WELL **SORGUM GULCH AQUIFER NO. 1**

FIELD

COUNTY **RIO BLANCO** STATE **COLORADO**

Location. API Serial No. **07174**

Sec. **7** Twp. **3S** Rge. **96W**

Other Services:

FDC-GR

CNL-GR

BHC-GR TEMP.

Permanent Datum: **GL** ; Elev.: **6909**
Log Measured From **GL** , **0** Ft. Above Perm. Datum
Drilling Measured From **GL**

Elev.: K.B. _____
D.F. _____
G.L. **6909**

Date	7-5-74					
Run No.	ONE					
Depth—Driller	1338					
Depth—Logger	1339					
Btm. Log Interval	1333					
Top Log Interval	166					
Casing—Driller	13-3/8@ 166			@	@	@
Casing—Logger	166					
Bit Size	12-1/4					
Type Fluid in Hole	WATER					
Fluid Level	410					
Dens.	Visc.					
pH	Fluid Loss		ml		ml	
Source of Sample						
R _m @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mf} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mc} @ Meas. Temp.	@	°F	@	°F	@	°F
Source: R _{mf} R _{mc}						
R _m @ BHT	@	°F	@	°F	@	°F
Time Since Circ.						
Max. Rec. Temp.	68	°F		°F		°F
Equip.	Location	7674	VERNAL			
Recorded By		HAUGAARD				
Witnessed By		TATE				

SCALE CHANGES

[illegible]

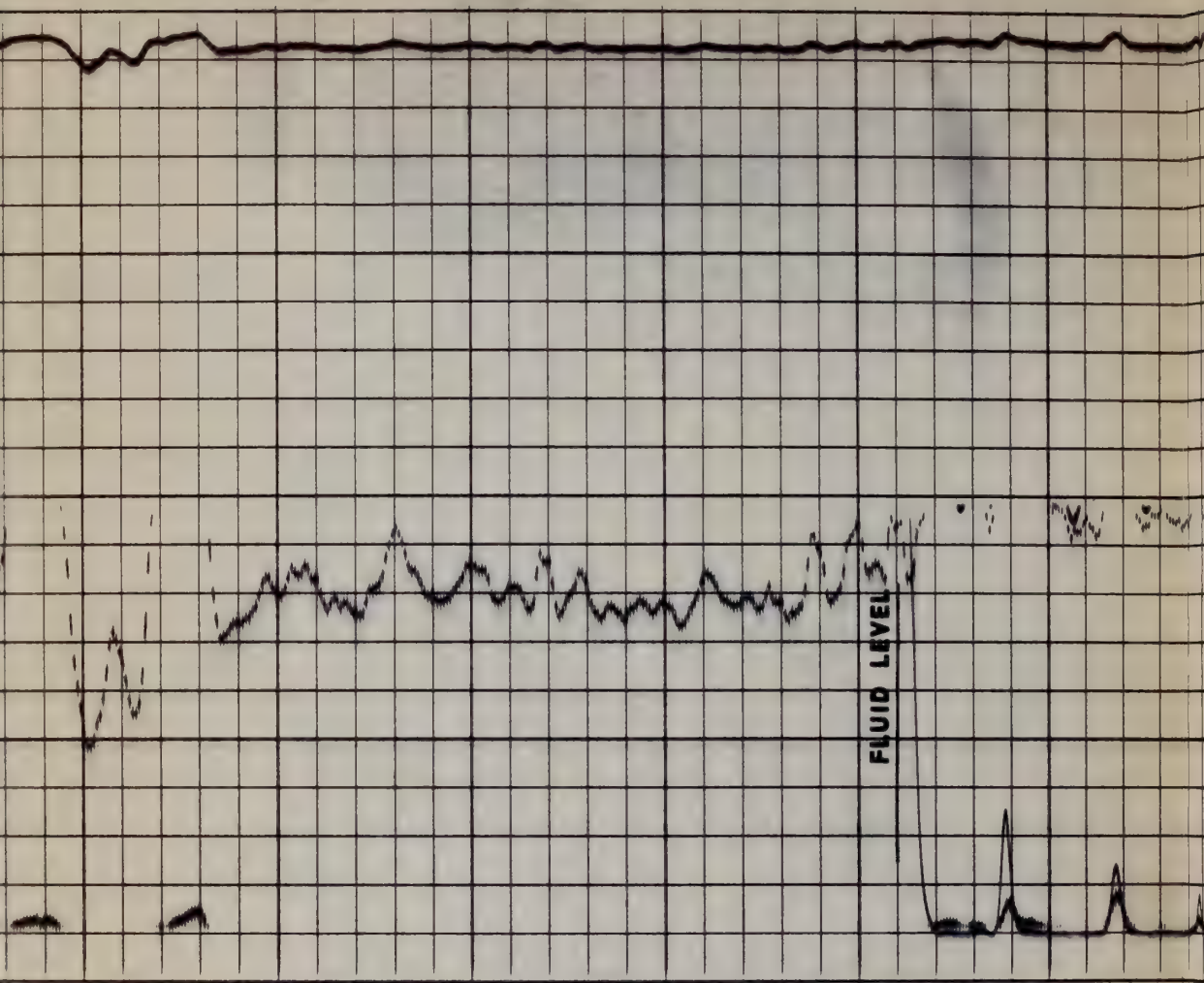
REMARKS

Service Order No. - S0 #07174

[illegible]

100

CALIBRATION.	BACKGND. CPS.	SOURCE CPS.	GALV. INCR. DIVISION	SENS. TAP (FOR CAL.)	SENS. TAP (RECORD)	TIME CONST.
GAMMA RAY.	—					

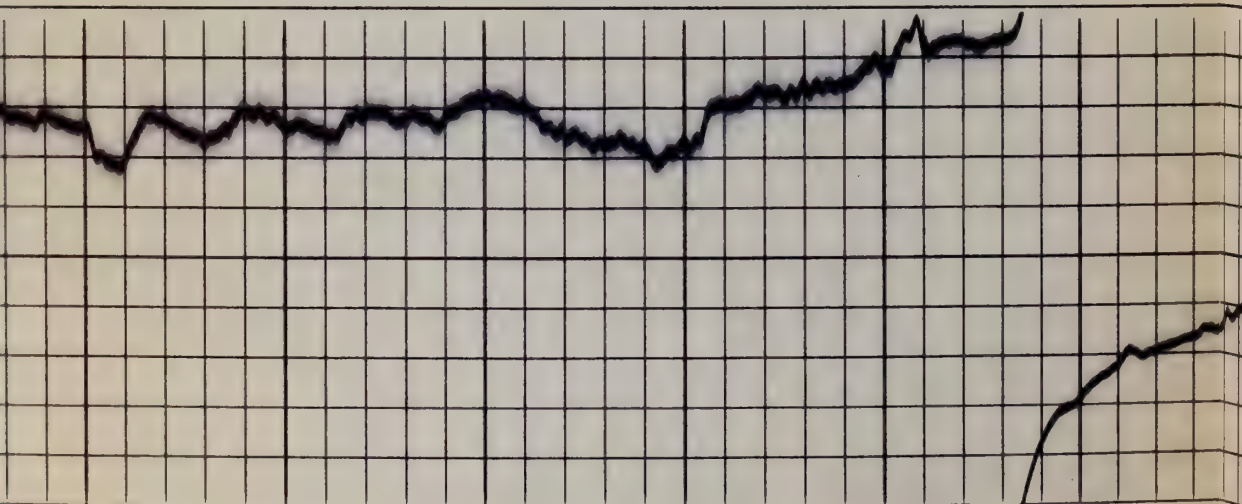


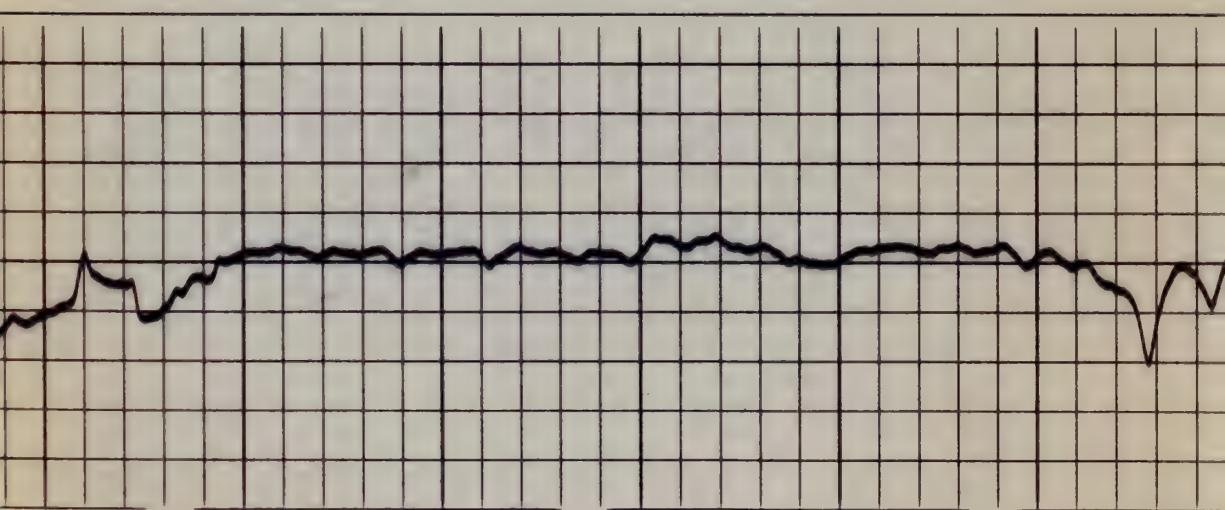
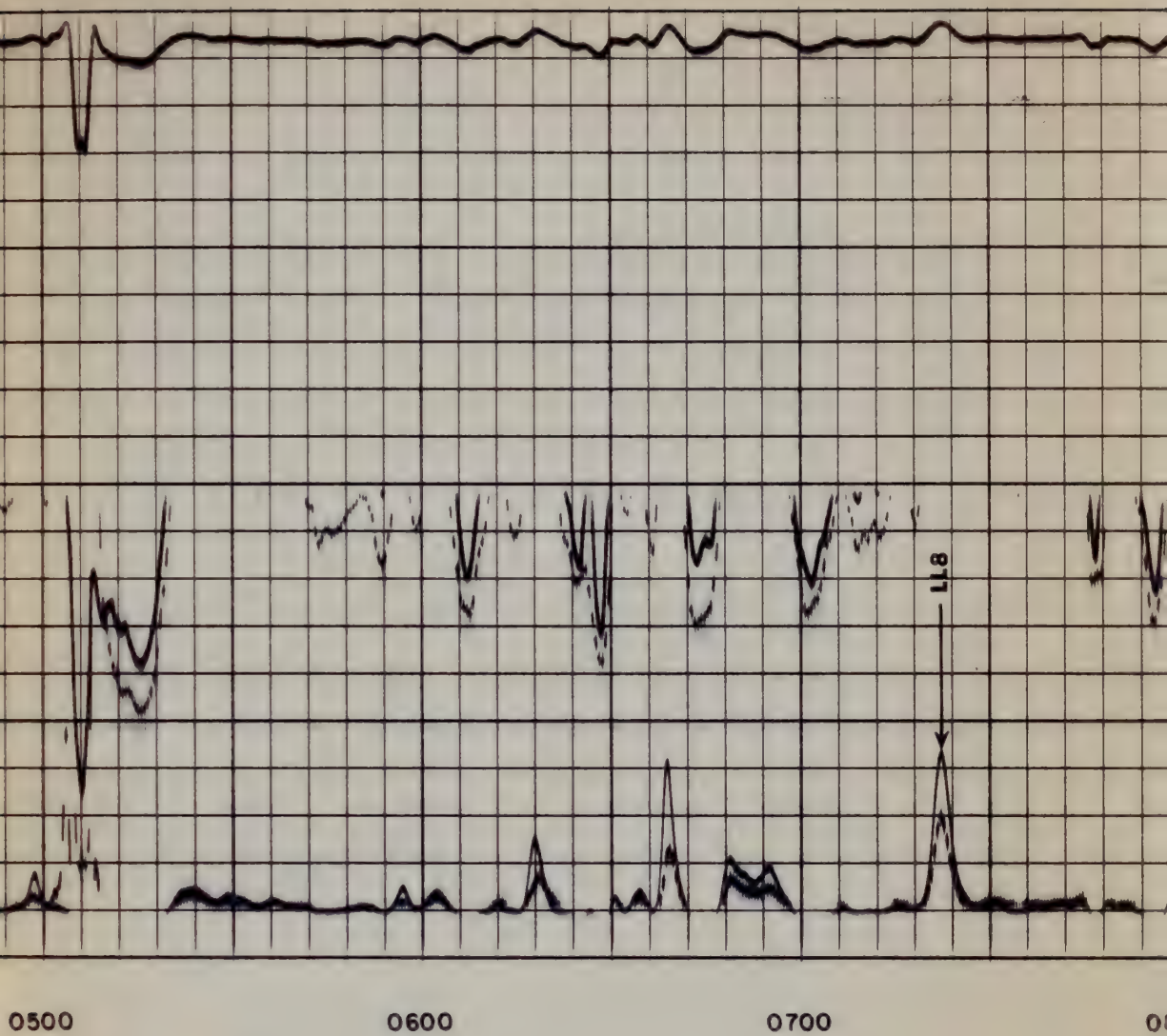
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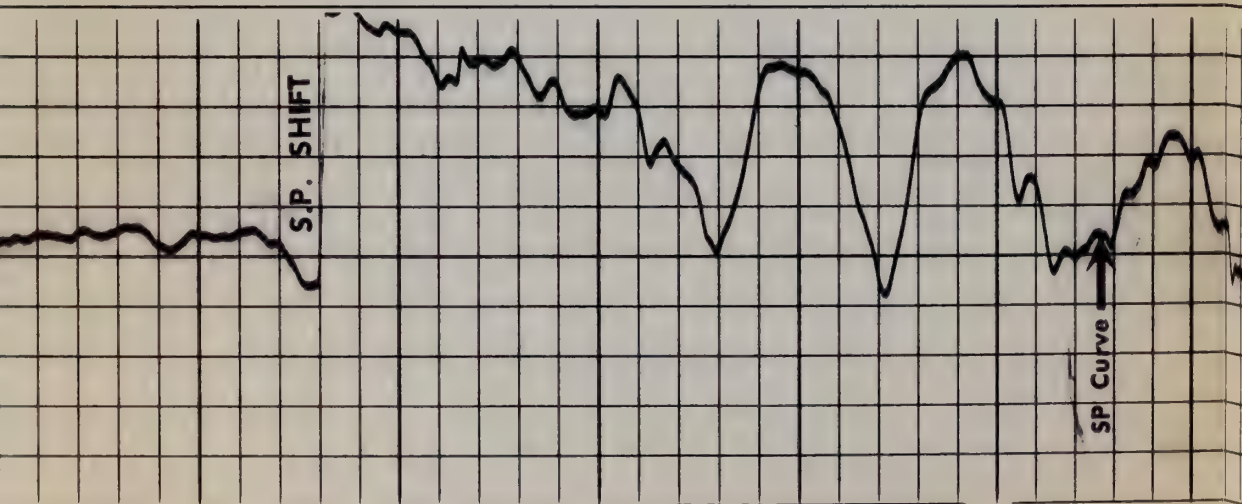
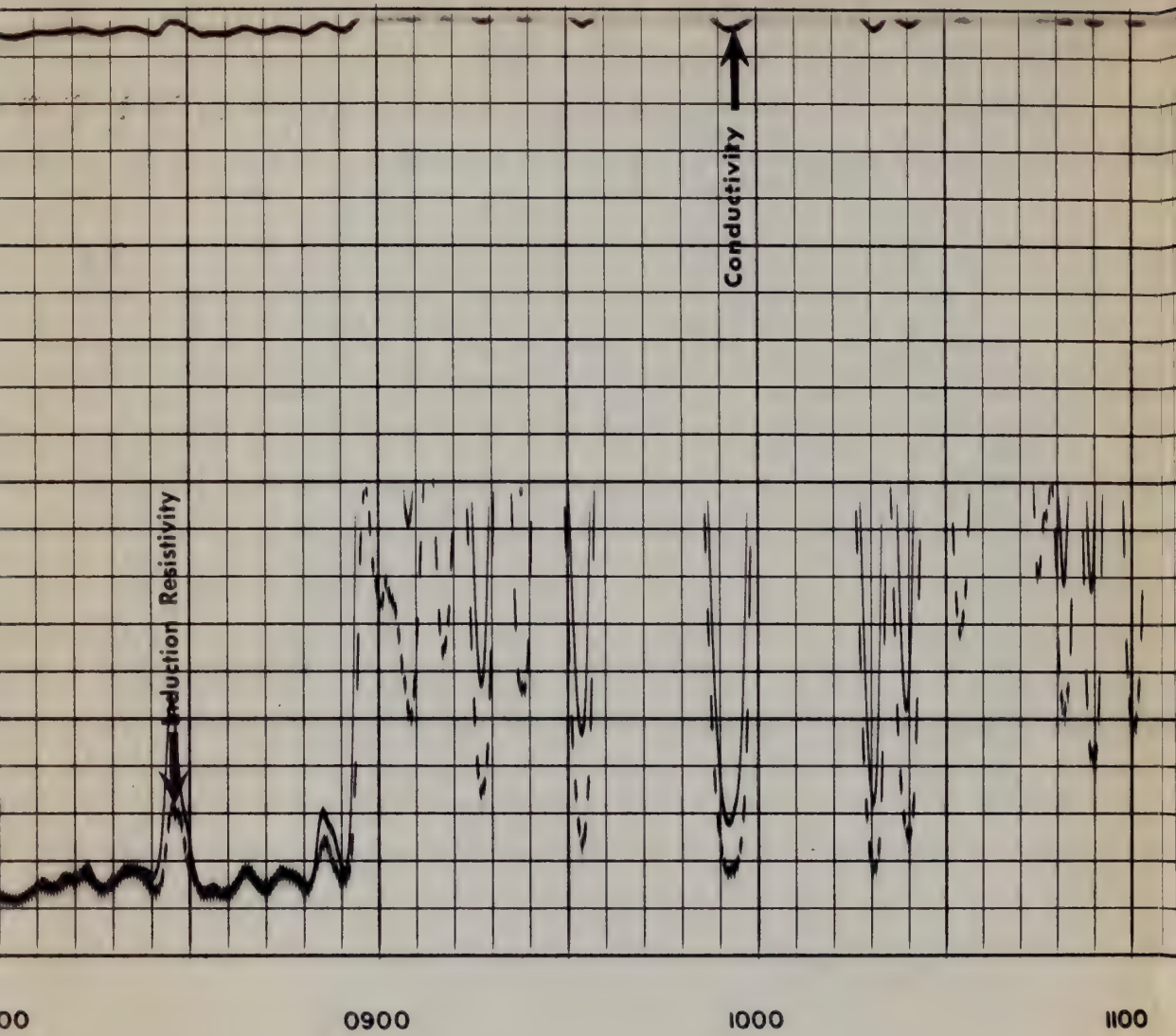
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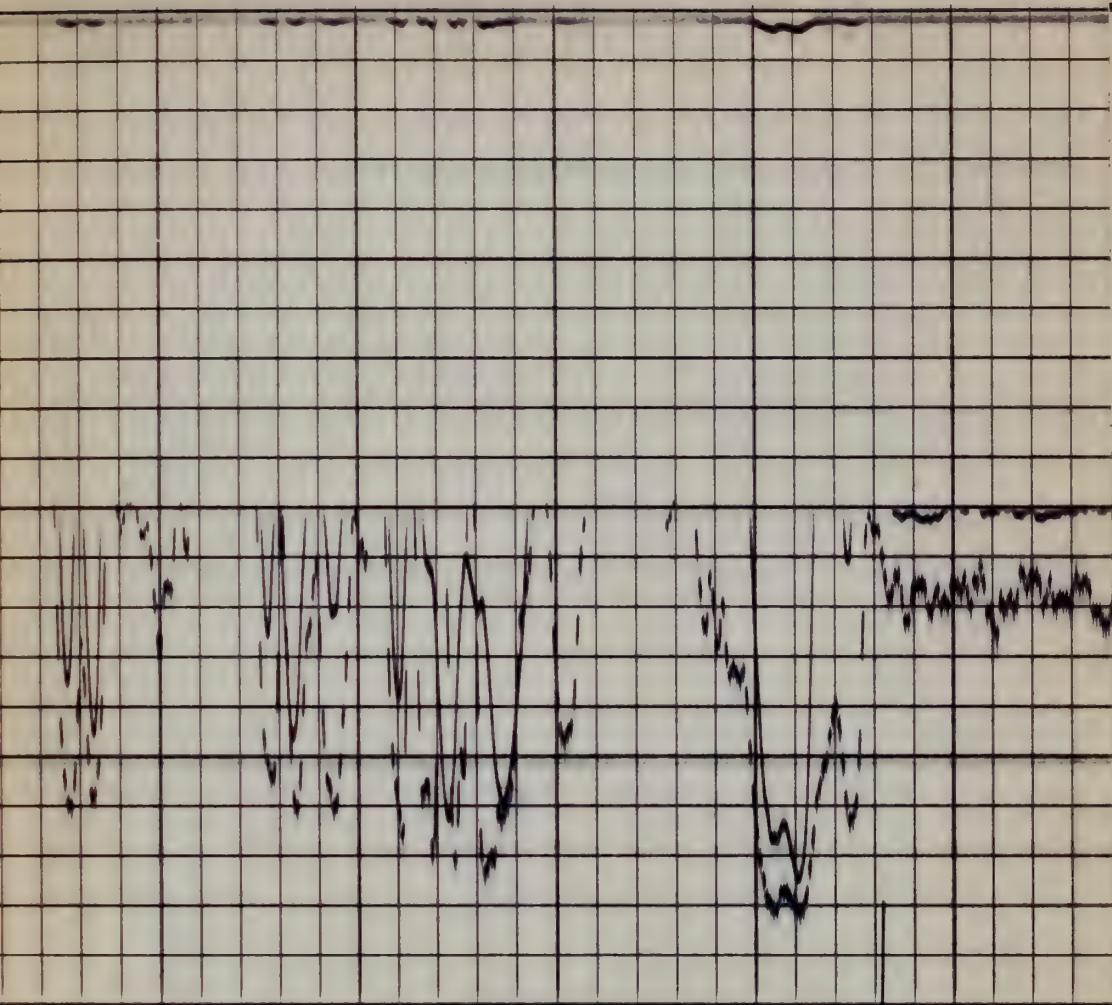
0400

0500



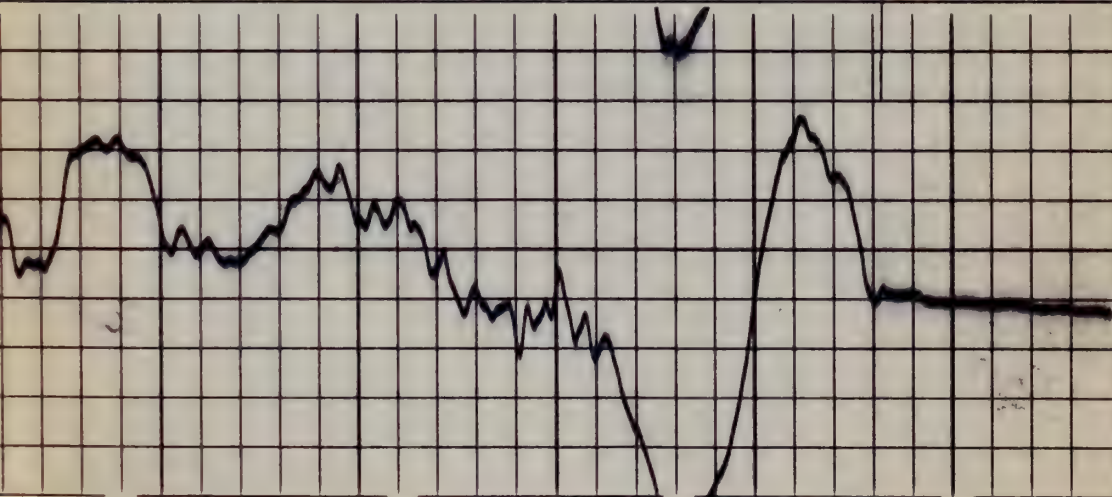






1200

1300

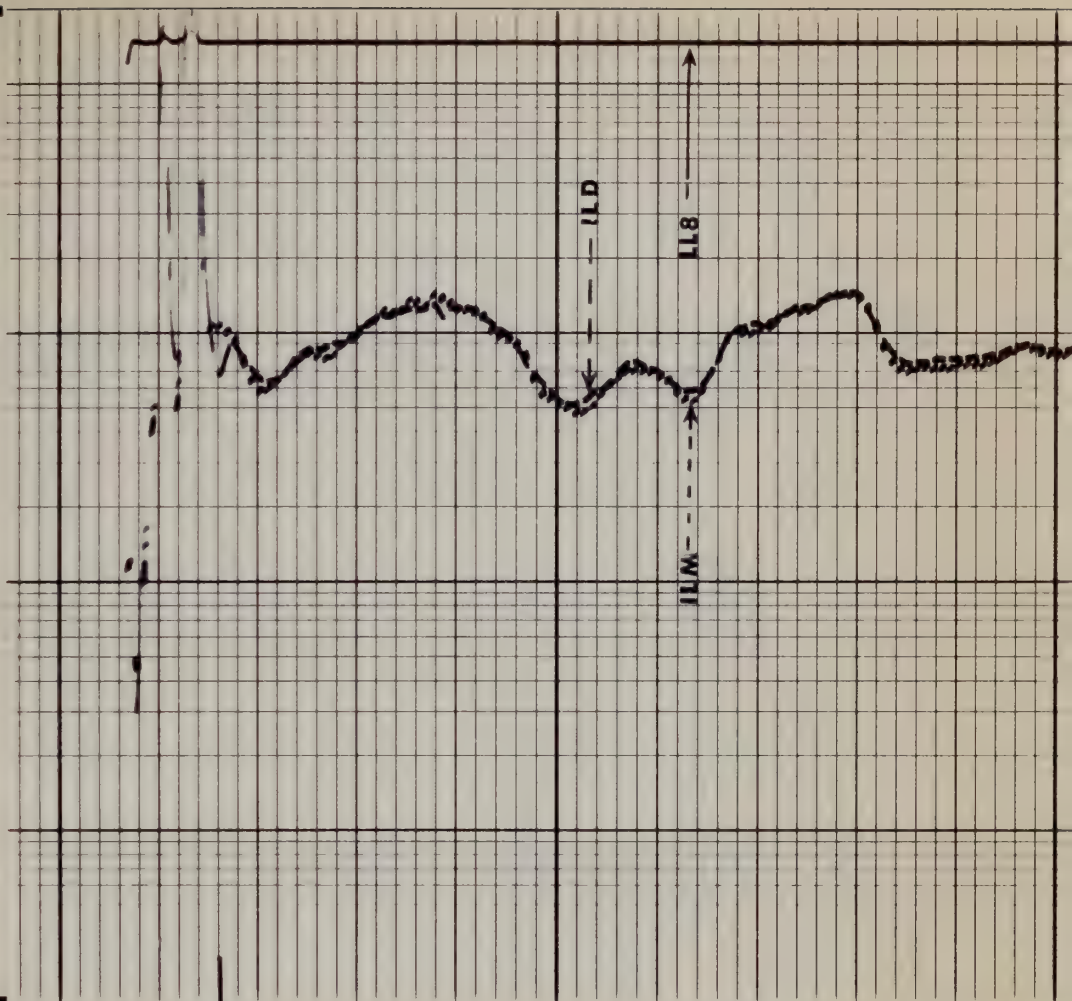


0
AVERAGED LATEROLOG — 8
100

		<div> <div> <div>0</div> <div>1000</div> </div> <div>DEEP INDUCTION LOG</div> <div> <div>0</div> <div>100</div> </div> <div> <div>0</div> <div>1000</div> </div> </div>	<div> <div>RESISTIVITY</div> <div>OHMS. M²/M</div> </div>	<div> <div>400</div> <div>200</div> <div>0</div> </div> <div>DEEP INDUCTION LOG</div>	<div> <div>SPONTANEOUS-POTENTIAL</div> <div>MILLIVOLTS</div> </div>	<div> <div>DEPTHS</div> </div>	<div> <div>CONDUCTIVITY</div> <div>MILLIMHOS/M = $\frac{1000}{\text{OHMS. M}^2/\text{M}}$</div> </div>

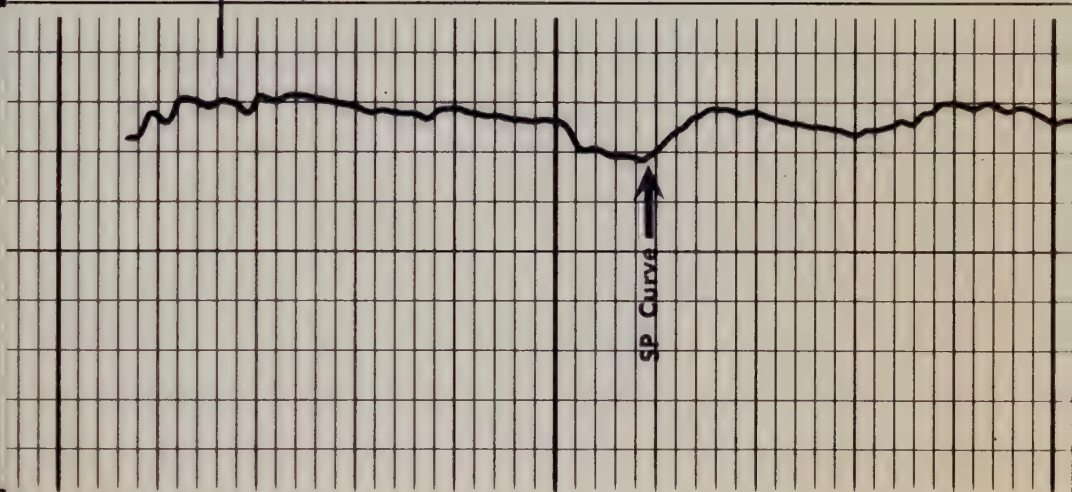
<div> <div>DETAIL LOG</div> <div>5" = 100'</div> </div>						
		<div> <div>SPONTANEOUS-POTENTIAL</div> <div>MILLIVOLTS</div> </div>	<div> <div>DEPTHS</div> </div>	<div> <div>RESISTIVITY</div> <div>OHMS. M²/M</div> </div>	<div> <div>DEEP INDUCTION LOG</div> <div> <div>0.2</div> <div>1.0</div> <div>10</div> <div>100</div> <div>1000</div> <div>2000</div> </div> </div>	<div> <div>MEDIUM INDUCTION LOG</div> <div> <div>0.2</div> <div>1.0</div> <div>10</div> <div>100</div> <div>1000</div> <div>2000</div> </div> </div>

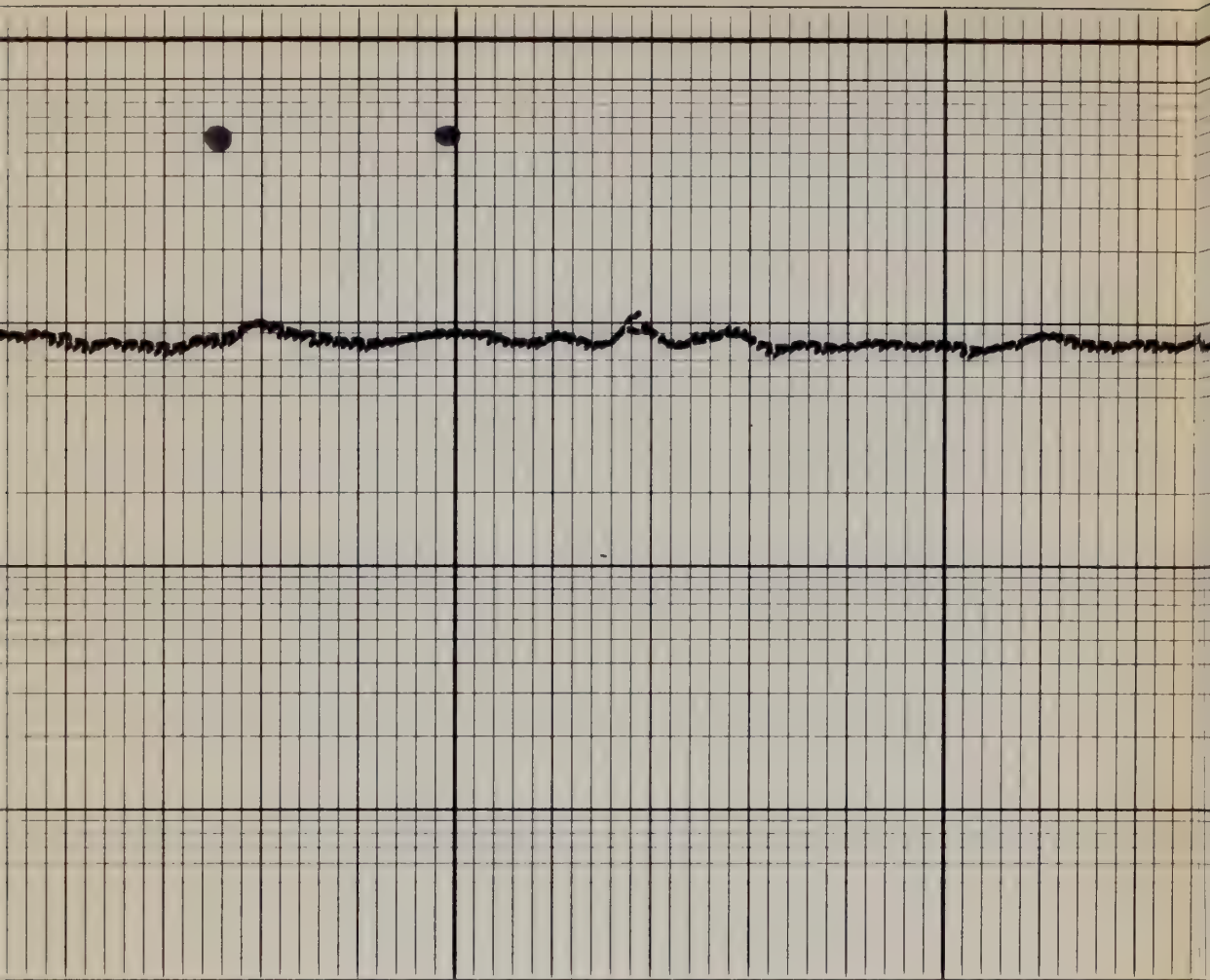
LATEROLOG -8



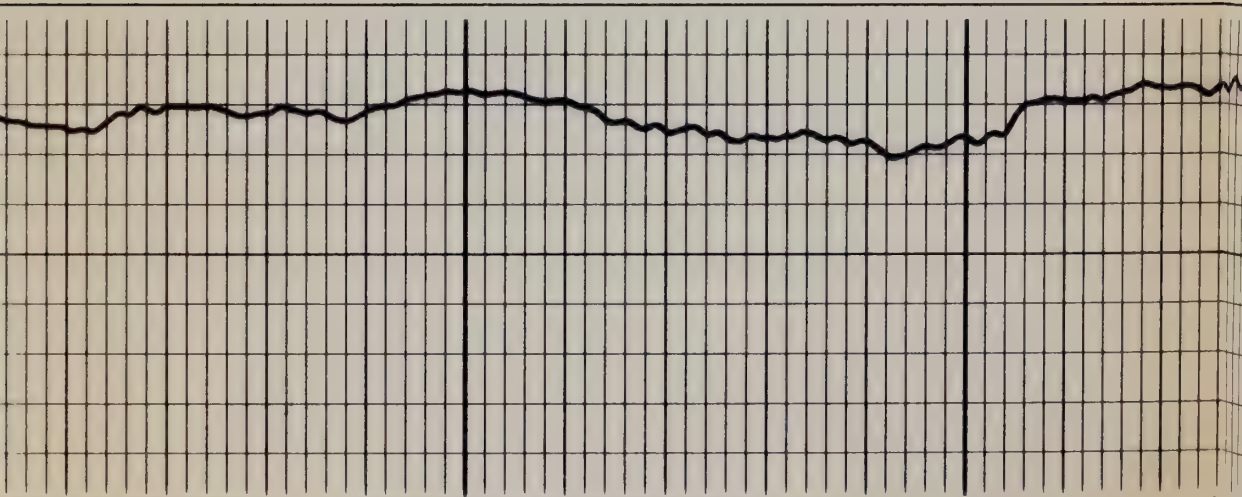
Casing

0200





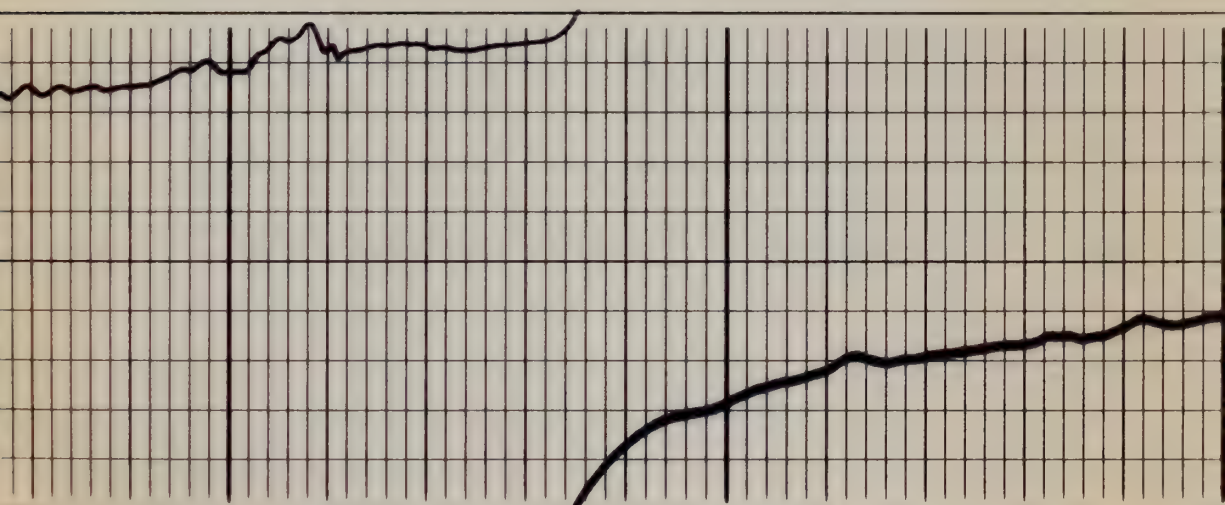
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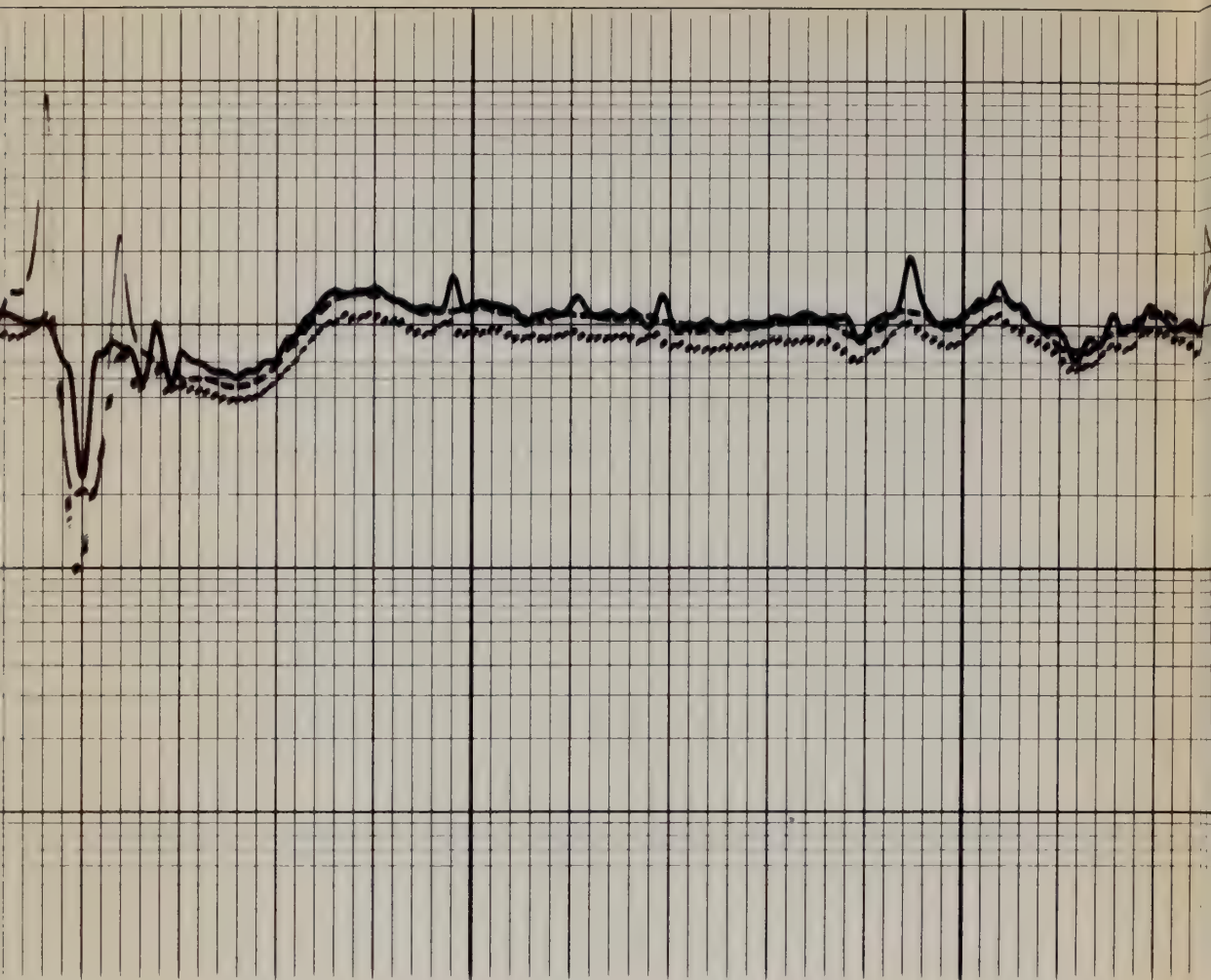




0400

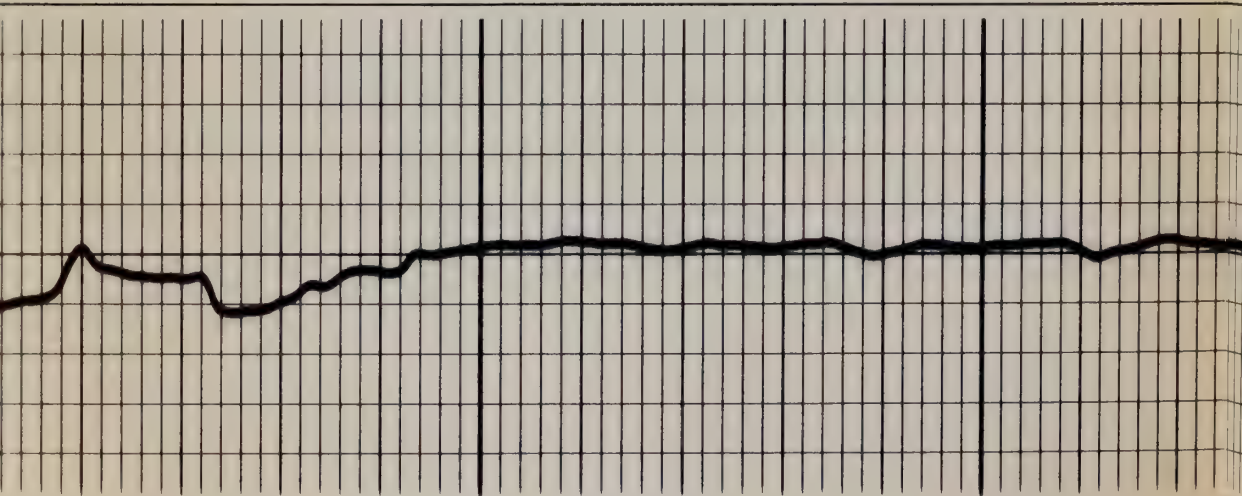
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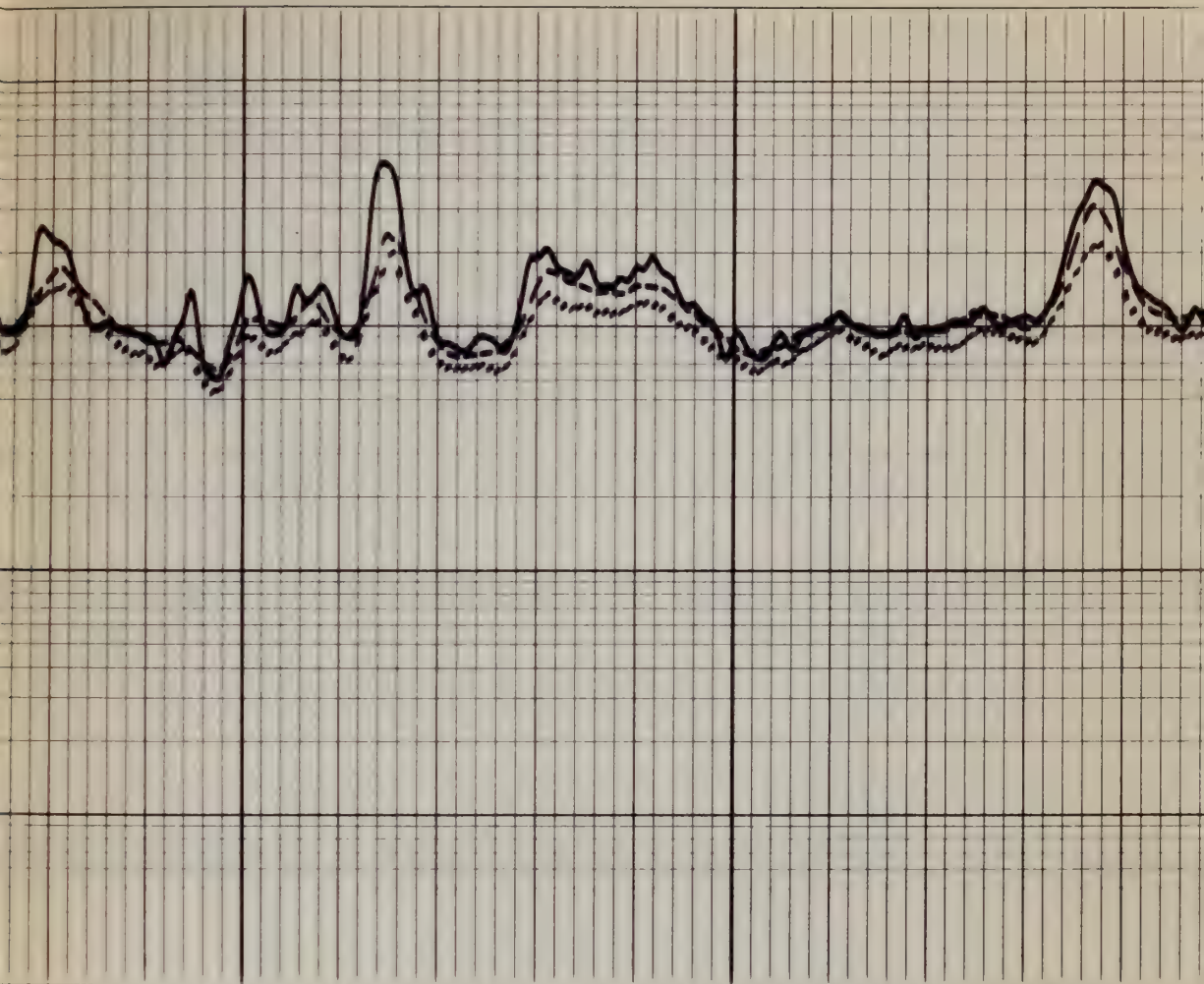




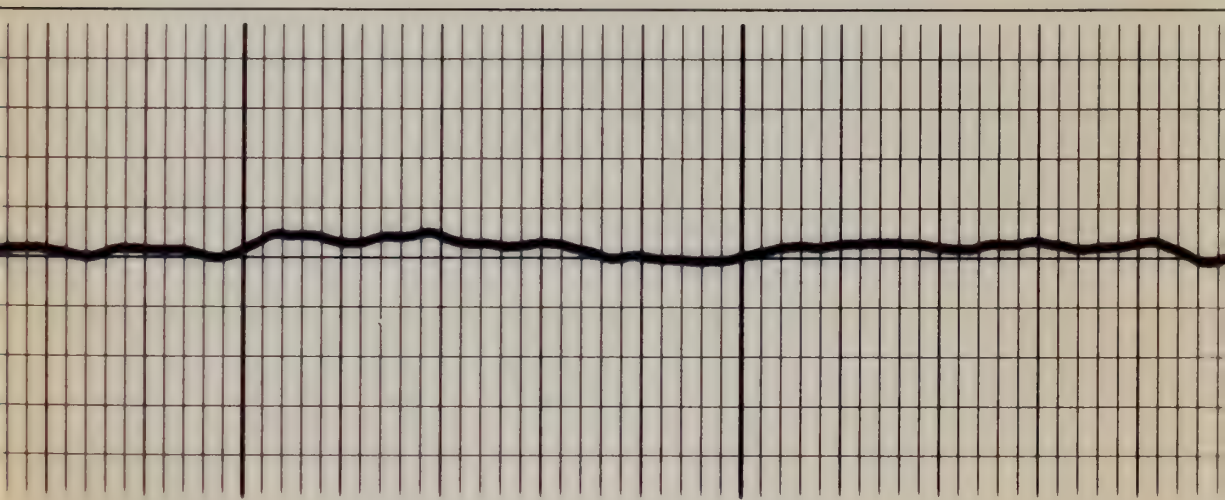
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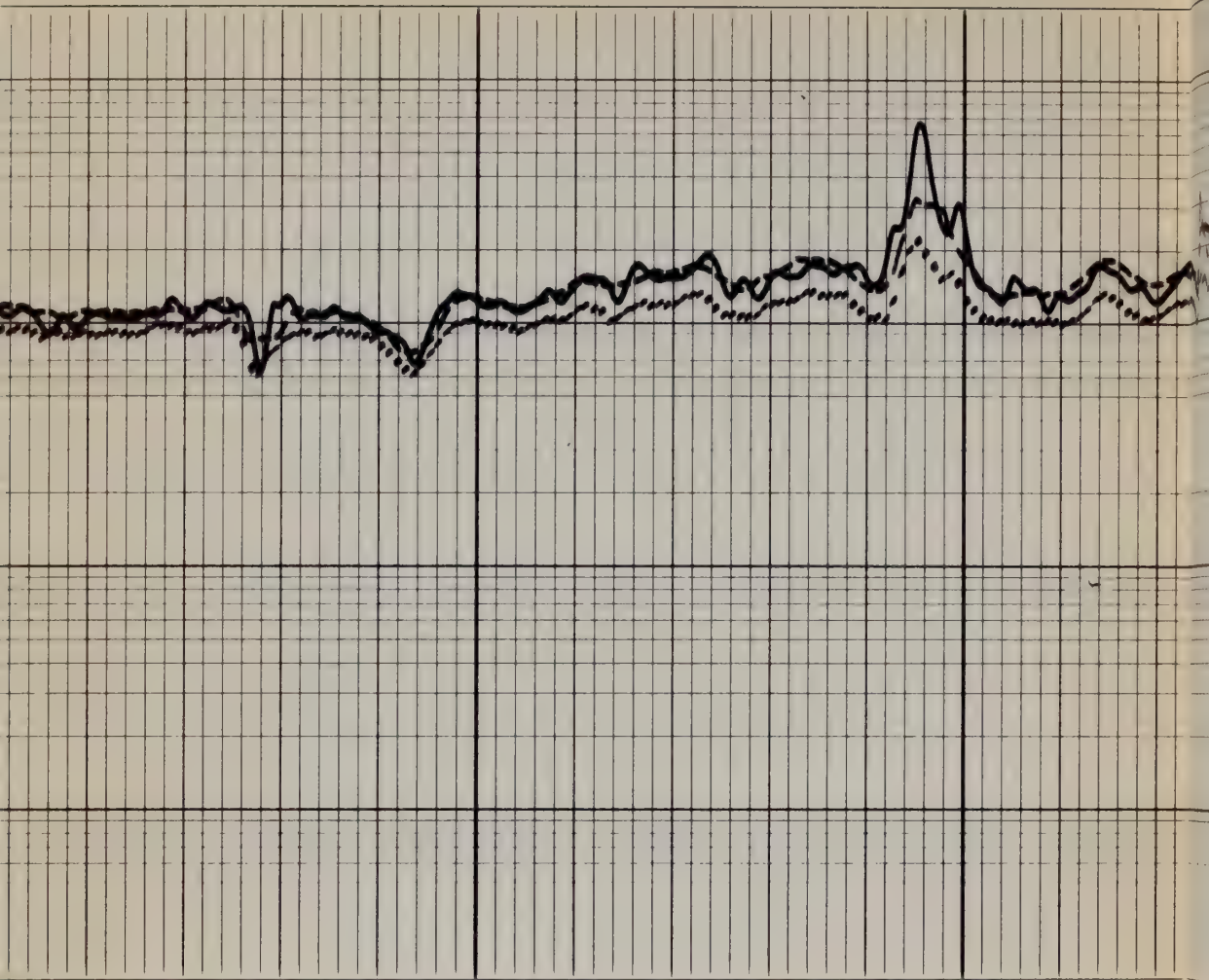
0600



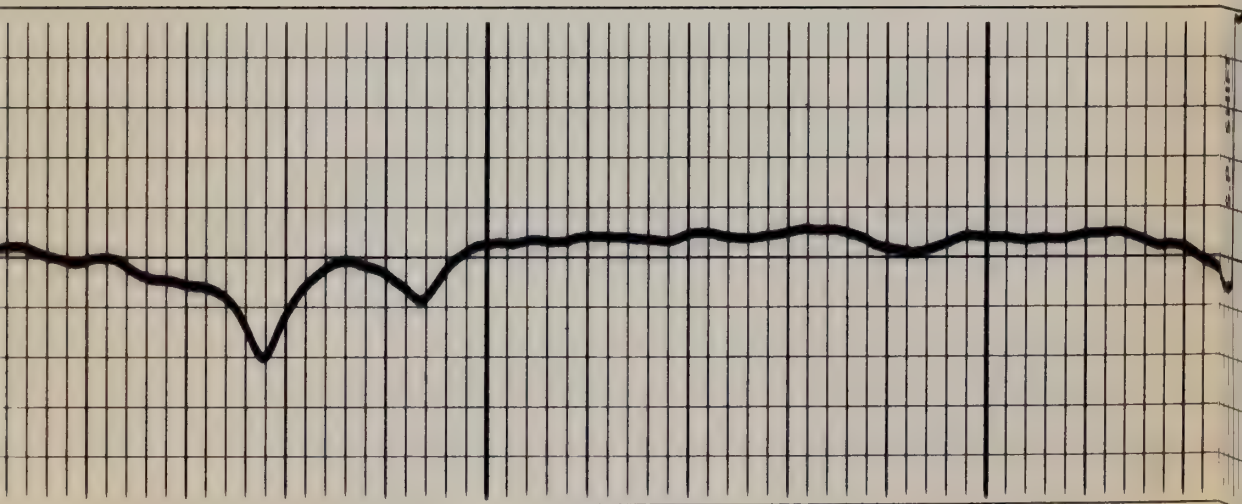


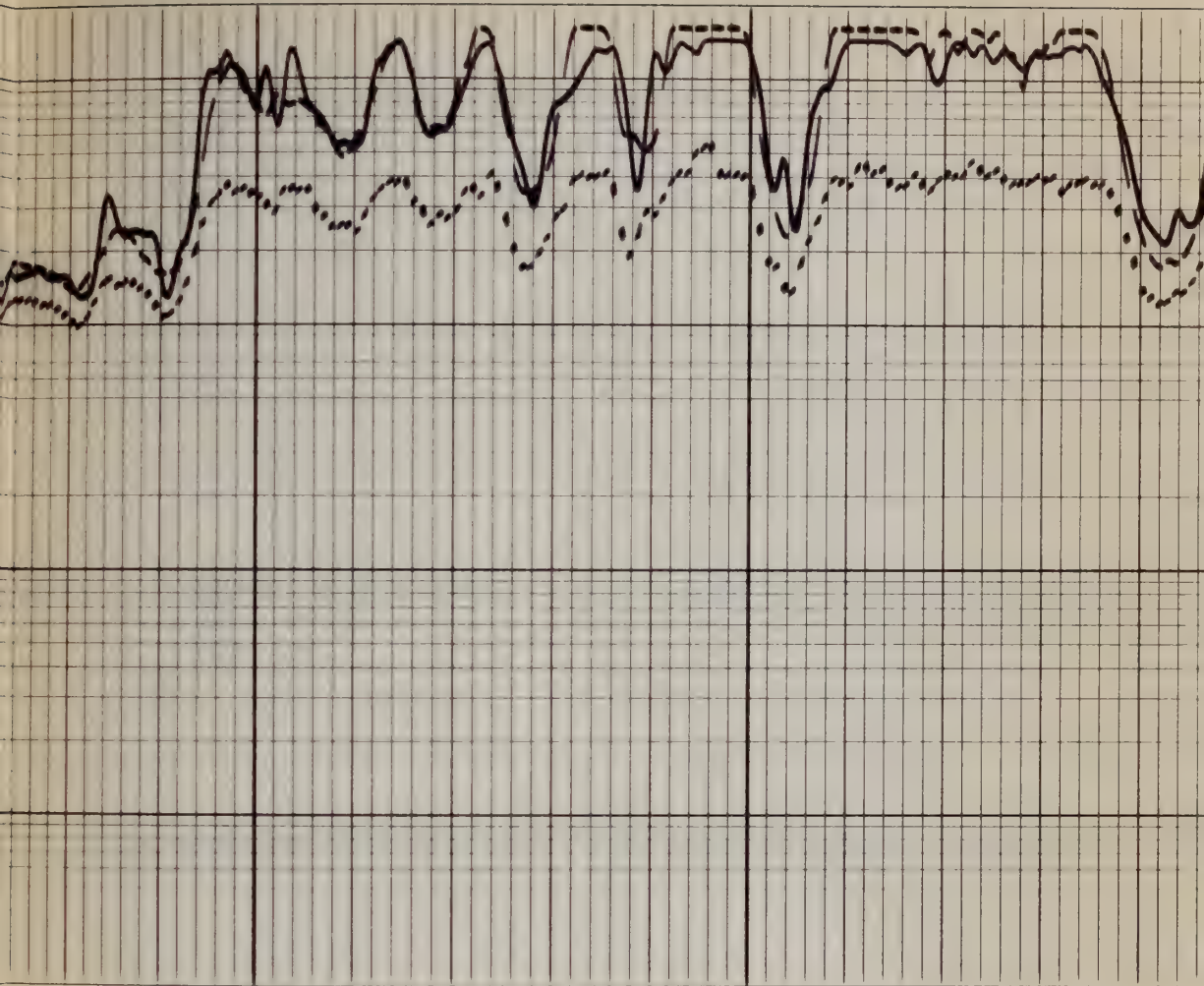
0700



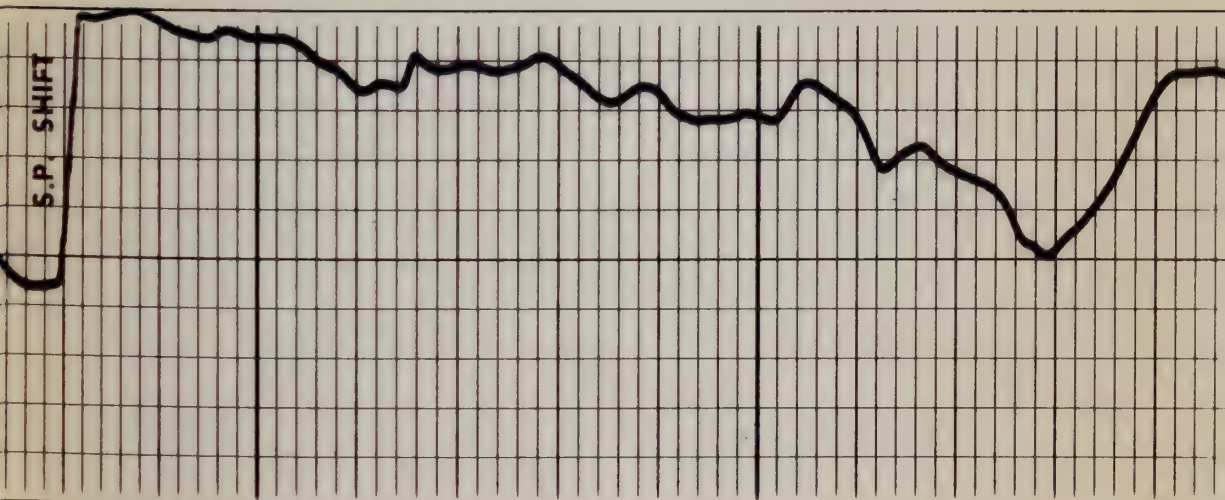


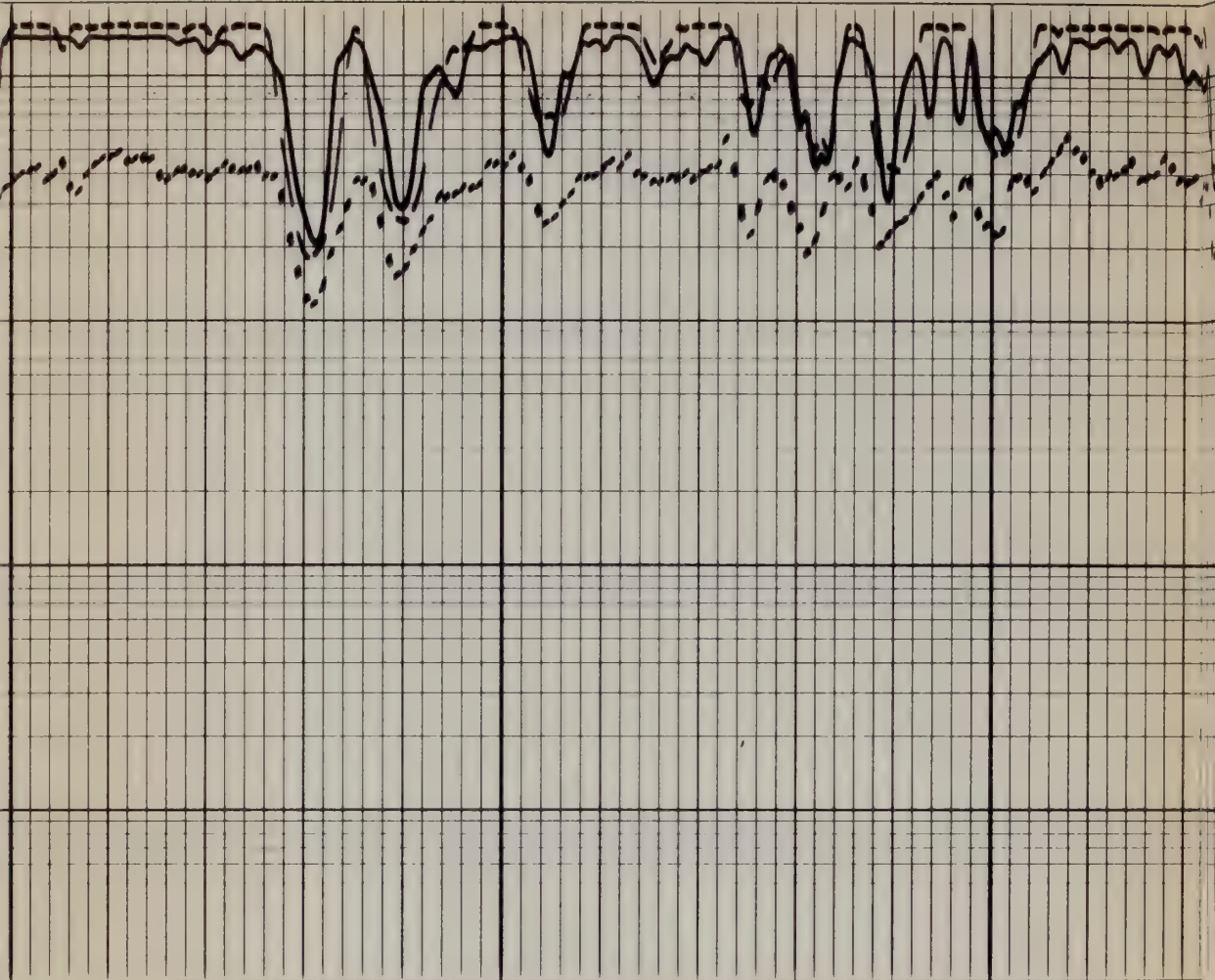
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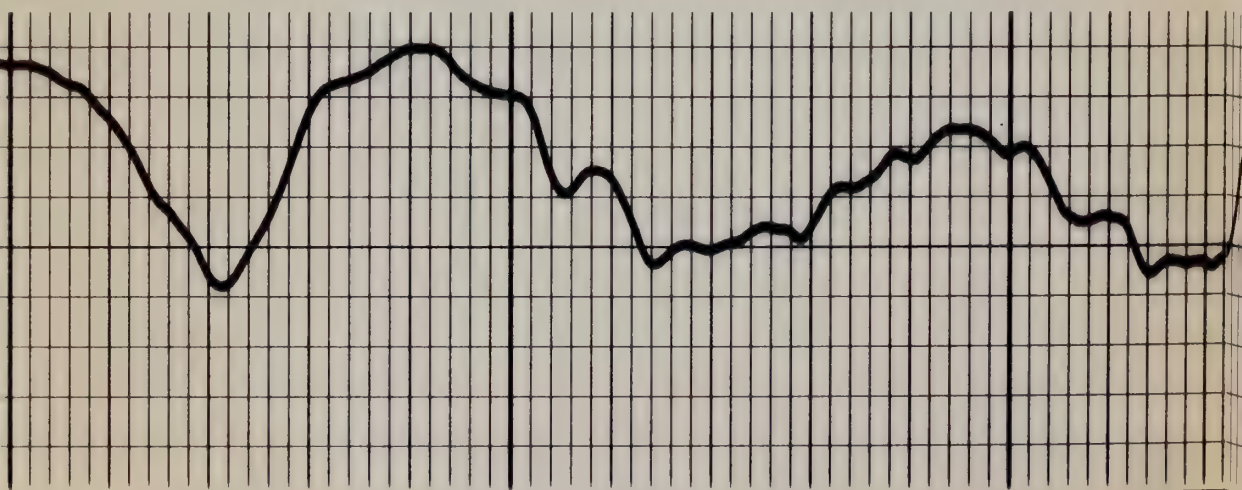
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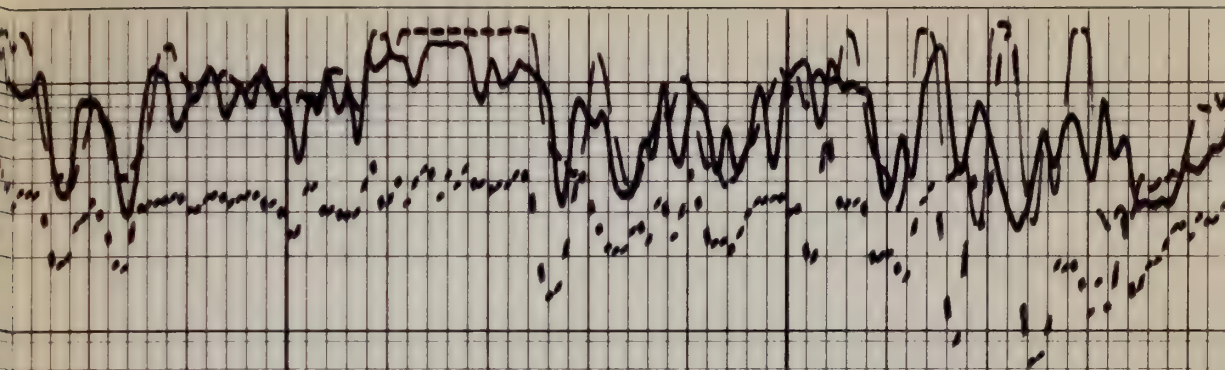




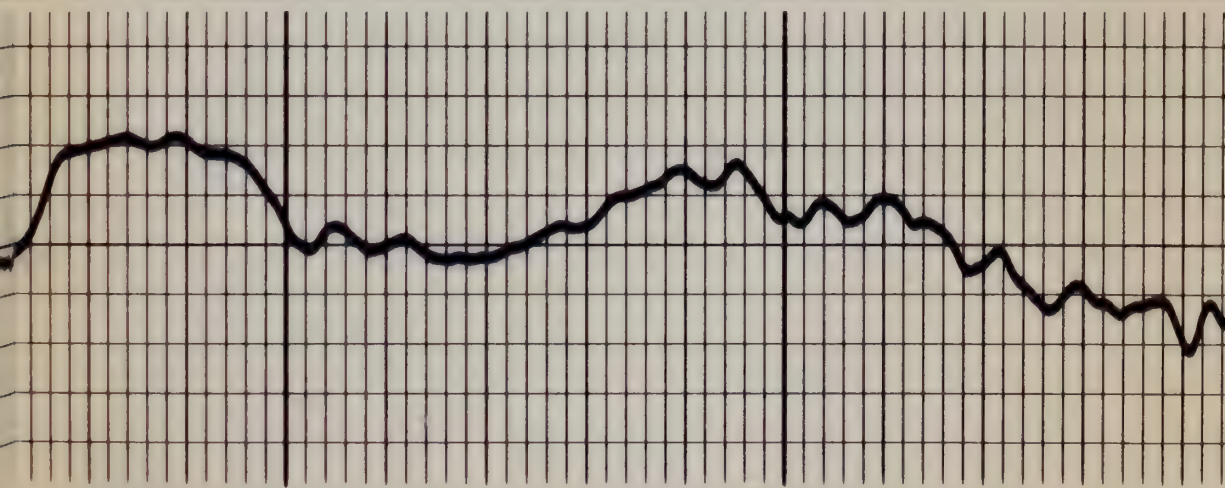
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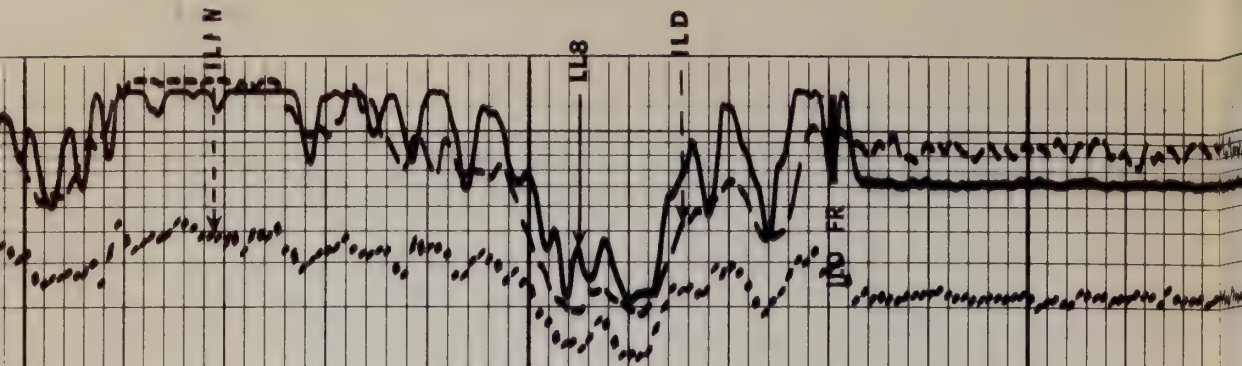
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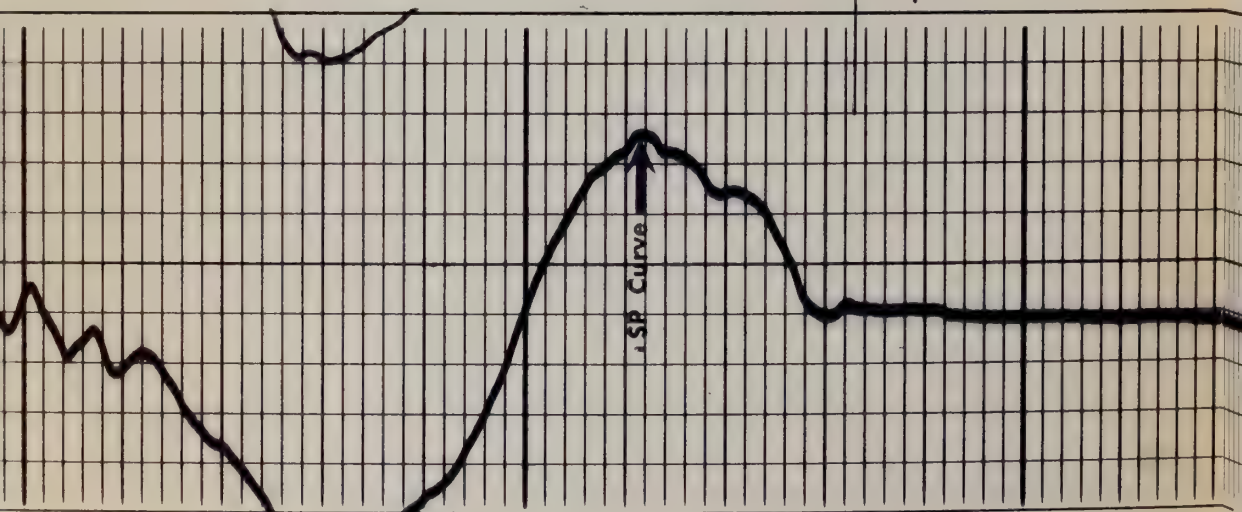


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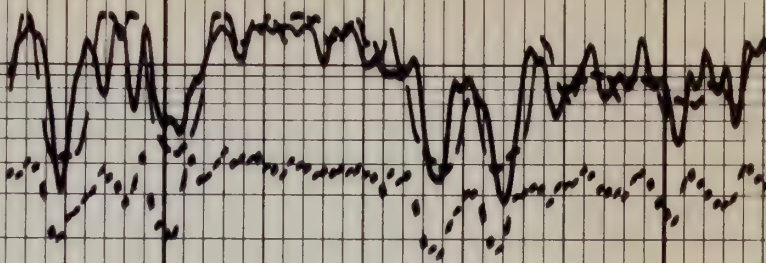
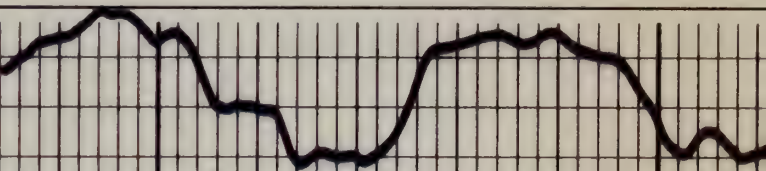


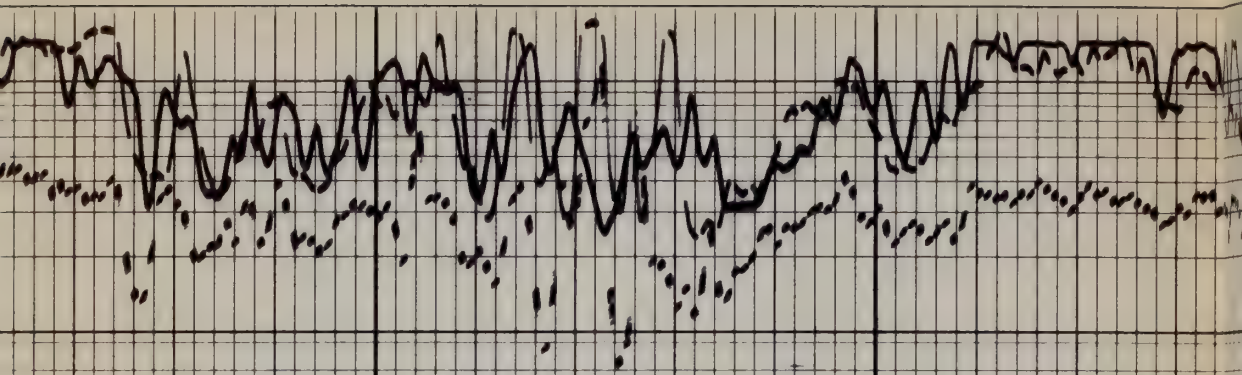
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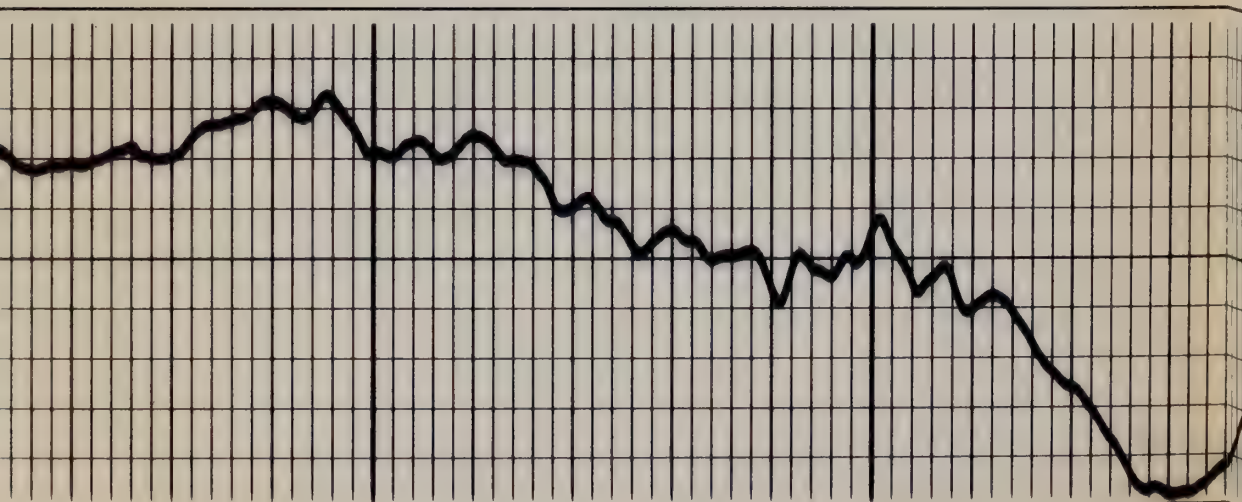
REPEAT SECTION

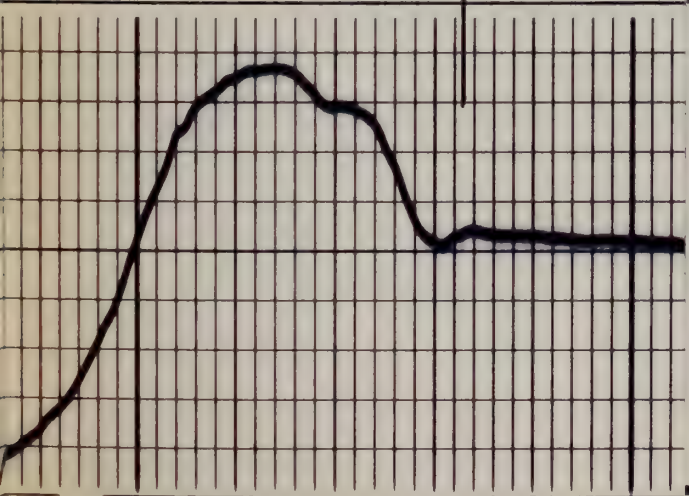
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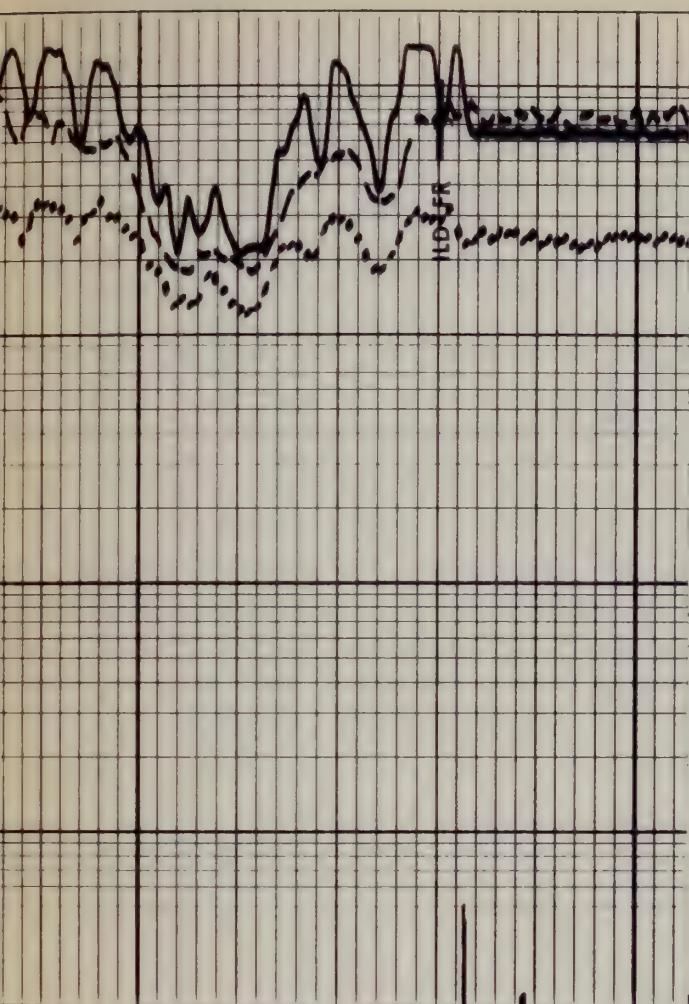


1200





1300



LATEROLOG - 8

MEDIUM INDUCTION LOG

DEEP INDUCTION LOG

— $\left| \begin{array}{c} 15 \\ \updownarrow \\ MV \end{array} \right| +$

SPONTANEOUS-POTENTIAL

MILLIVOLTS

DEPTHS

RESISTIVITY

OHMS. M^2/M

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1333

SCHL. TD 1339

DRIL. TD 1338

Elev:

KB

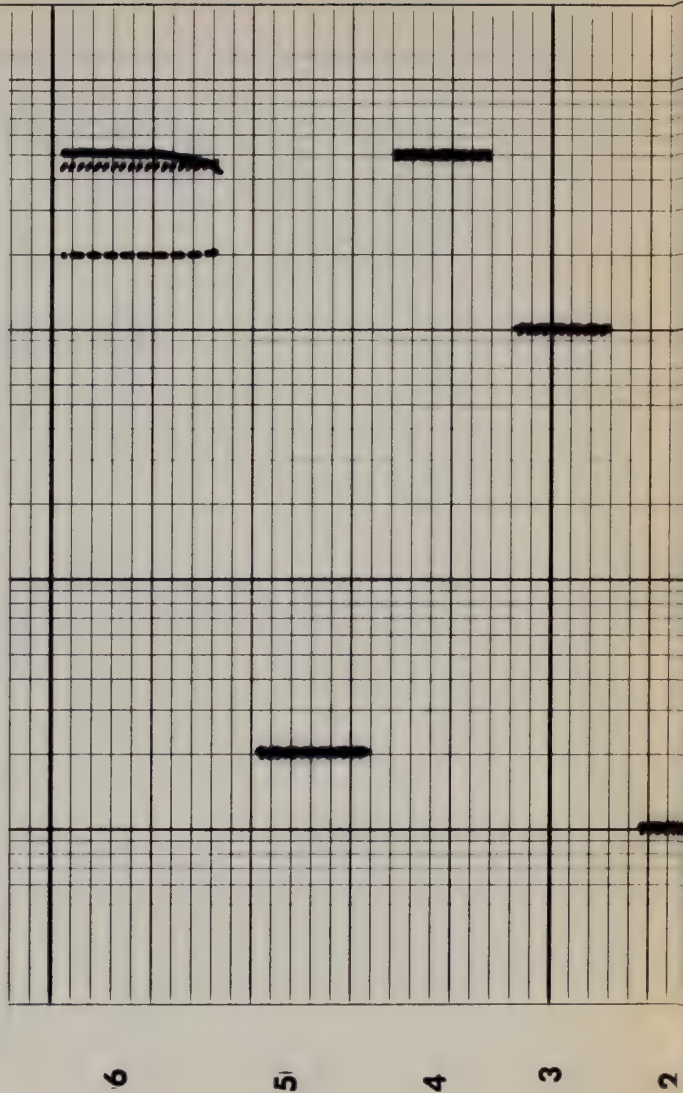
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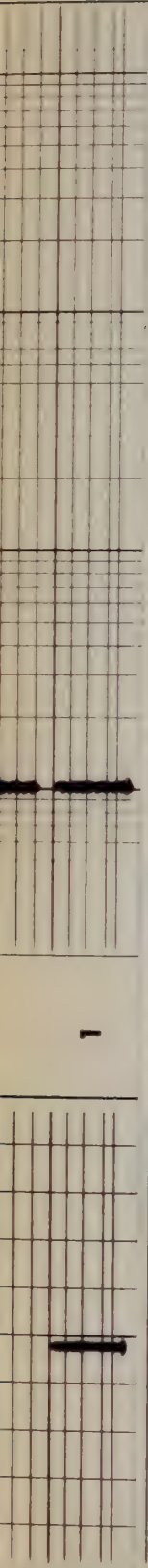
GL 6909

CALIBRATION RECORD

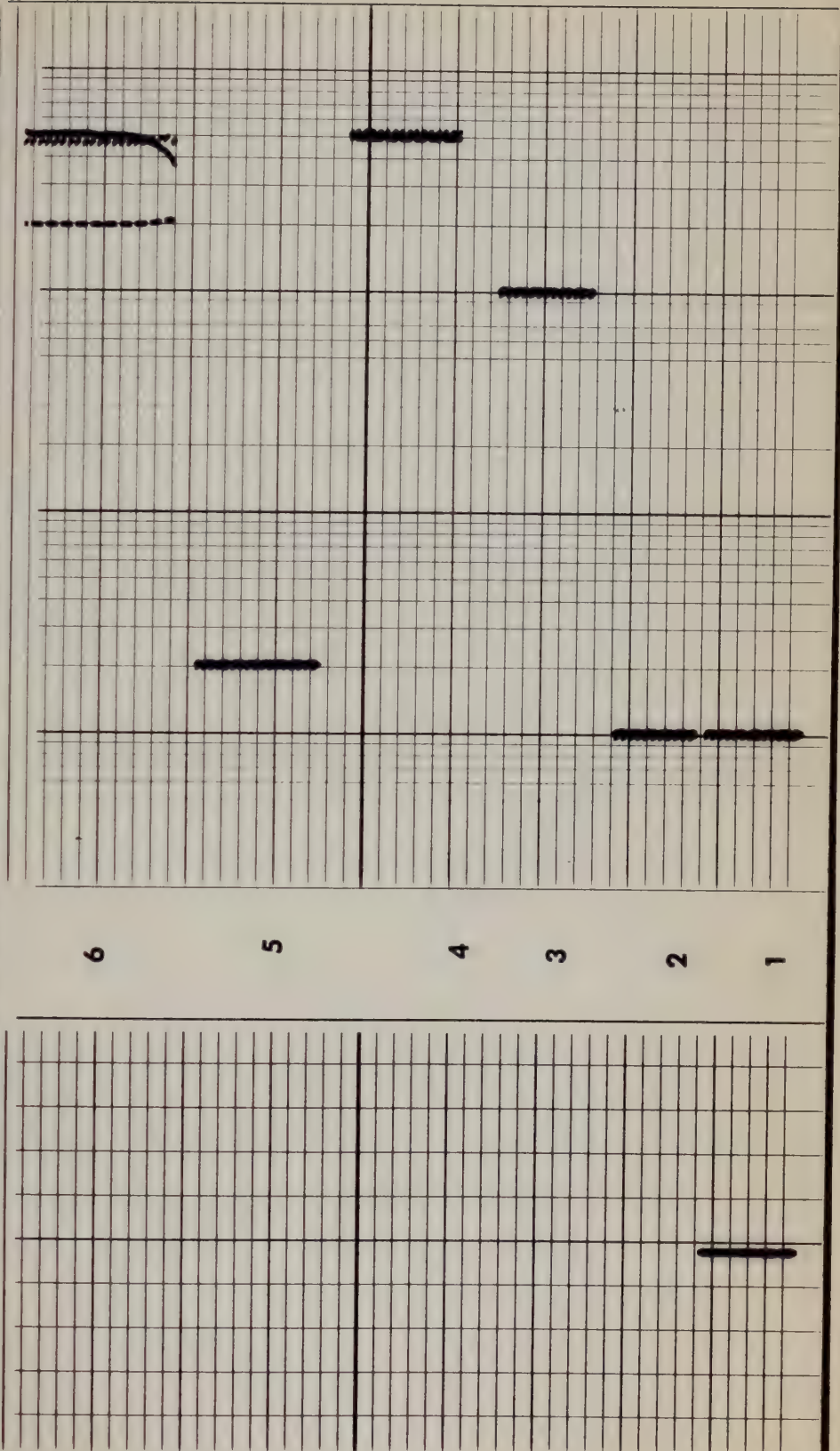


Calibration after Survey





Calibration before Survey



DUAL INDUCTION CALIBRATION FILM CODING

1. MECHANICAL ZERO

2. 1 OHM-M
3. 100 OHM-M
4. ELECTRICAL ZERO (500 OHM-M)
5. 2 OHM-M
6. SONDE ERRORS (+2 MMHO)
7. ZERO SIGNAL IN AIR
8. 1ld TEST LOOP (2 OHM SIGNAL)
9. 1lm TEST LOOP (2 OHM SIGNAL)
10. Rxo/Rt UNITY
11. Rxo/Rt CALIBRATE



CALIBRATION RECORD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1333

SCHL. TD 1339

DRLR TD 1338

Elev: KB ----

DF ----

GL 6909

Schlumberger

COMPENSATED FORMATION DENSITY LOG

Gamma-Gamma

COUNTY

FIELD or
LOCATION

WELL

WELL

SORGUM GULCH AQU-
IFER NO. 1

ATLANTIC RICHFIELD

COMPANY

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

Location:

API Serial No. 07174

Sec. 7 Twp. 3S Rge. 96W

Other Services:

DIL TEMP.
CNL-GR
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL , 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-5-74			
Run No.	ONE			
Depth-Driller	1338			
Depth-Logger	1339			
Btm. Log Interval	1337			
Top Log Interval	162			
Casing-Driller	13-3/8 @166	@	@	@
Casing-Logger	162			
Bit Size	12-1/4			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens.	Visc.			
pH	Fluid Los	ml	ml	ml
Source of Sample				
R _m @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R _{mf} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
R _{mc} @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: R _{mf} R _{mc}				
R _m @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.				
Max. Rec. Temp.	68 °F	°F	°F	°F
Equip. Location	7674 VERNAL			
Recorded By	HAUGAARD			
Witnessed By	TATE			

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

Date	Sample No.			
Depth - Driller				
Type Fluid				
Source of Sample				
Rm $\bar{\alpha}$ Meas. Temp.	($\bar{\alpha}$)	$^{\circ}\text{F}$	($\bar{\alpha}$)	$^{\circ}\text{F}$
Rmf $\bar{\alpha}$ Meas. Temp.	($\bar{\alpha}$)	$^{\circ}\text{F}$	($\bar{\alpha}$)	$^{\circ}\text{F}$
Rmc $\bar{\alpha}$ Meas. Temp.	($\bar{\alpha}$)	$^{\circ}\text{F}$	($\bar{\alpha}$)	$^{\circ}\text{F}$
Rm $\bar{\alpha}$ BHT	($\bar{\alpha}$)	$^{\circ}\text{F}$	($\bar{\alpha}$)	$^{\circ}\text{F}$
Dens.	Visc.			
ph	Fluid Loss	ml		ml
ρ_o Water by Vol.				
ρ_o Oil by Vol.				
ρ_o Solids by Vol.				
Solids Av. Sp. Gr.				

EQUIPMENT DATA

Run No.	ONE			
Panel No.	EA-355			
Cart No.	EA-263			
Skid No.	D-1095			
Sonde No.	E-235			
Source	2940			
Calibrator	545			
GR Cart.	J-98			
TTR	----			
Mem Panel	A-173			

BIT SIZE / CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
12-	1338	166	13-		166	SURF.
1/4			3/4			

SCALE CHANGES

Type Lag	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA

FDC Selectors				
Liquid Density	Grain Density	Hole Fluid	Porosity Scale	To
1.00	2.65	LIQUID	30/TK	TD
				CSG

REMARKS

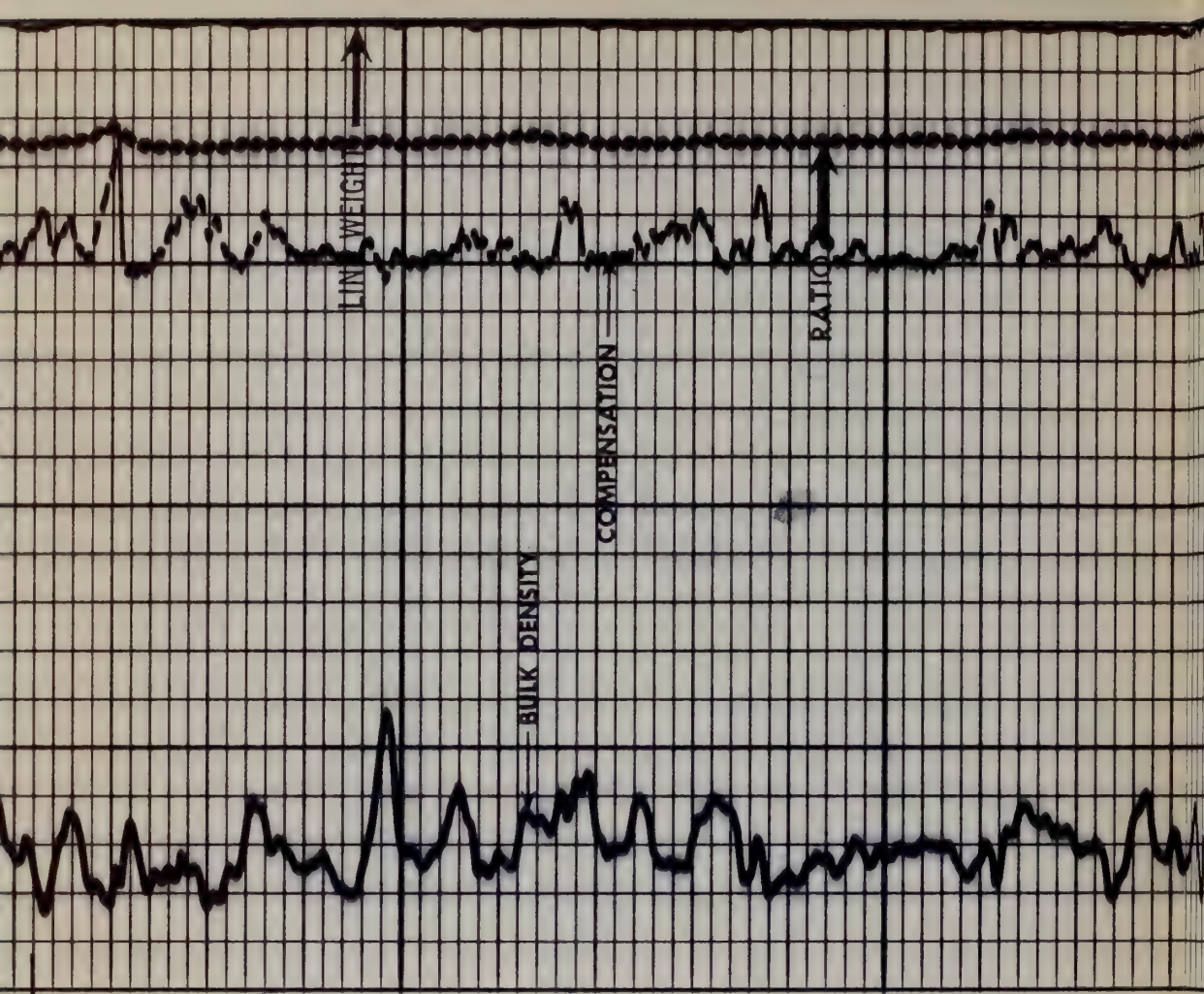
Service Order No. - S0 #07174

CALIBRATION DATA

Run No.	Gamma Ray		FDC — Before Log — ACPS		FDC — After Log — ACPS	
	API Scale	Background CPS	Total CPS	P ₁	P ₂	P ₂
1	0-200	100	500	416	688	688
2						
3						
4						

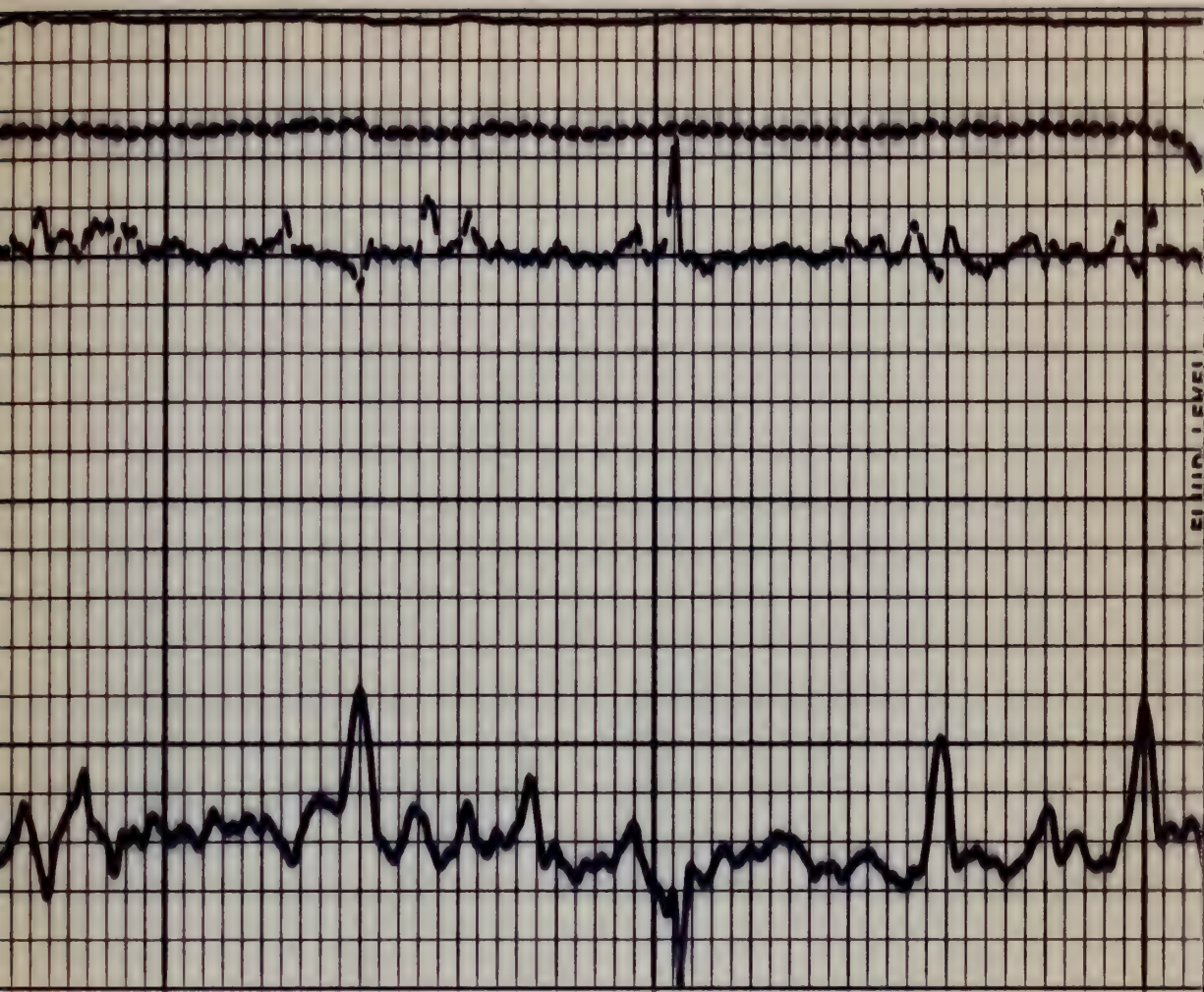
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

CALIPER		DEPTHS	CORRECTION	
HOLE DIAM. IN INCHES			GRAMS/CC.	
8	18		RATIO	
			5.0	0
			2.5	
			-.25	0
				.25
GAMMA RAY			BULK DENSITY	
API UNITS			GRAMS CC.	
0	150		2.0	3.0
150	300		1.0	2.0
			INCREMENTAL WEIGHT LINE →	



Casing

0200

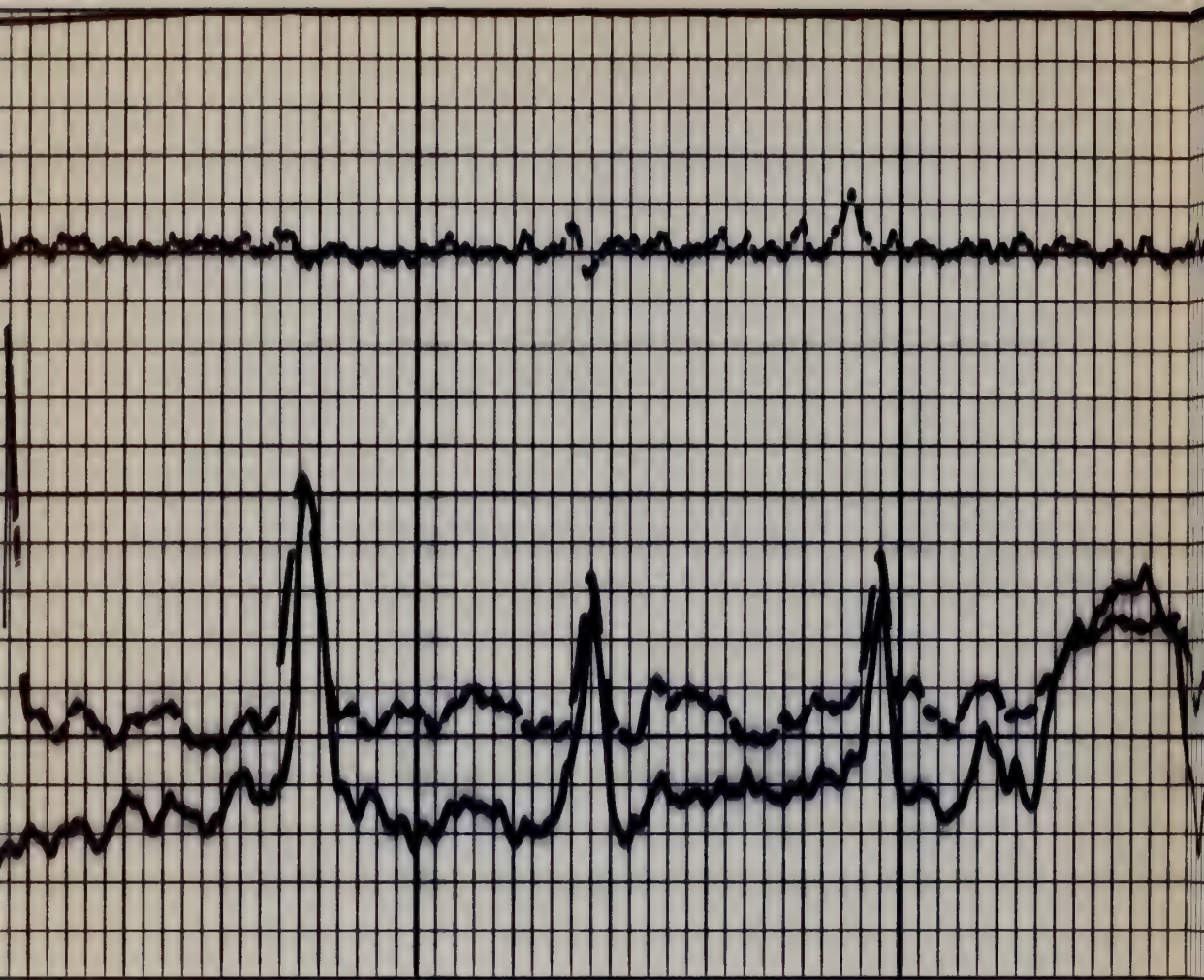


ECG LEVEL

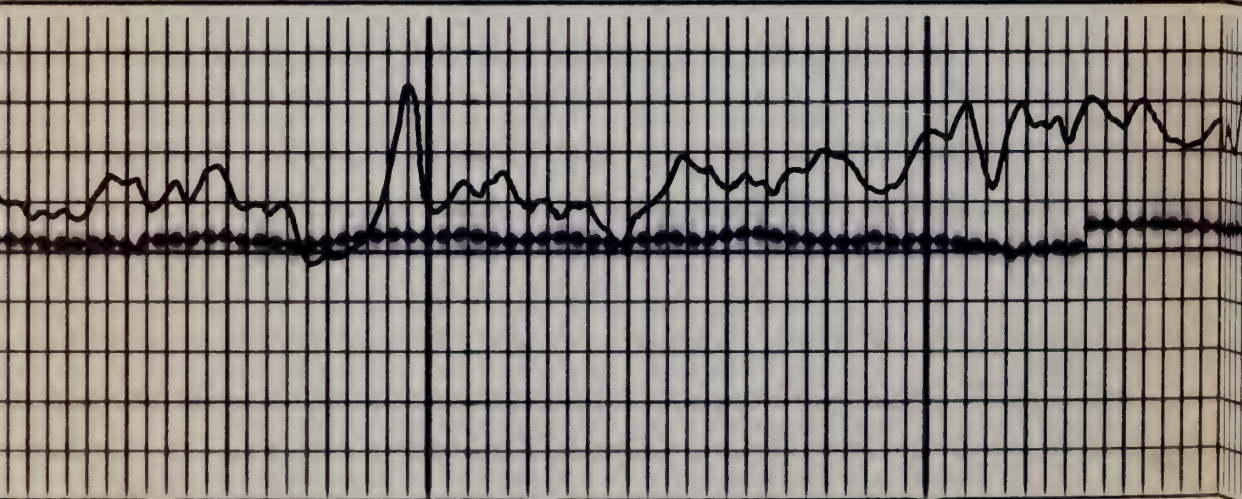
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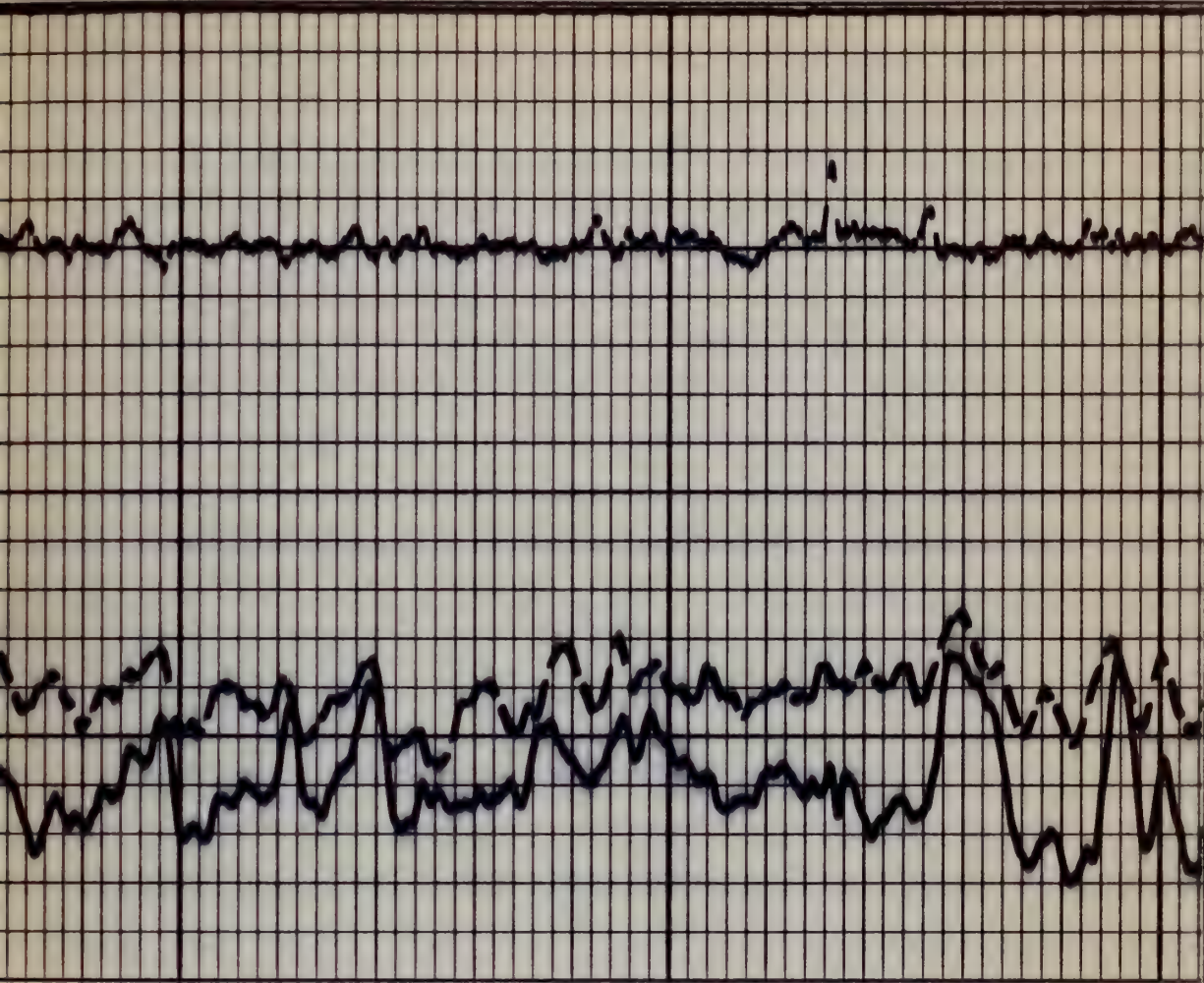
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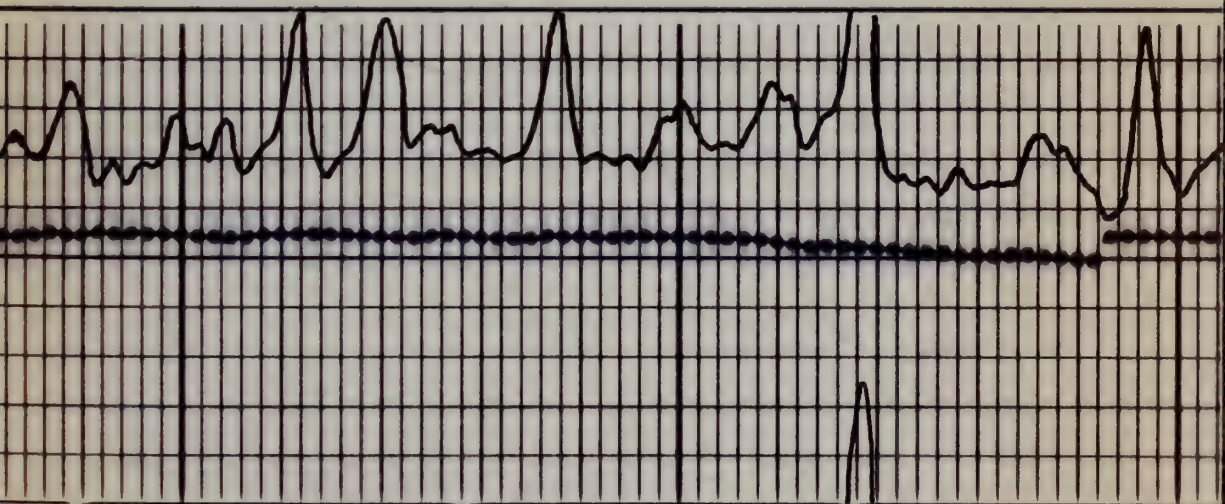


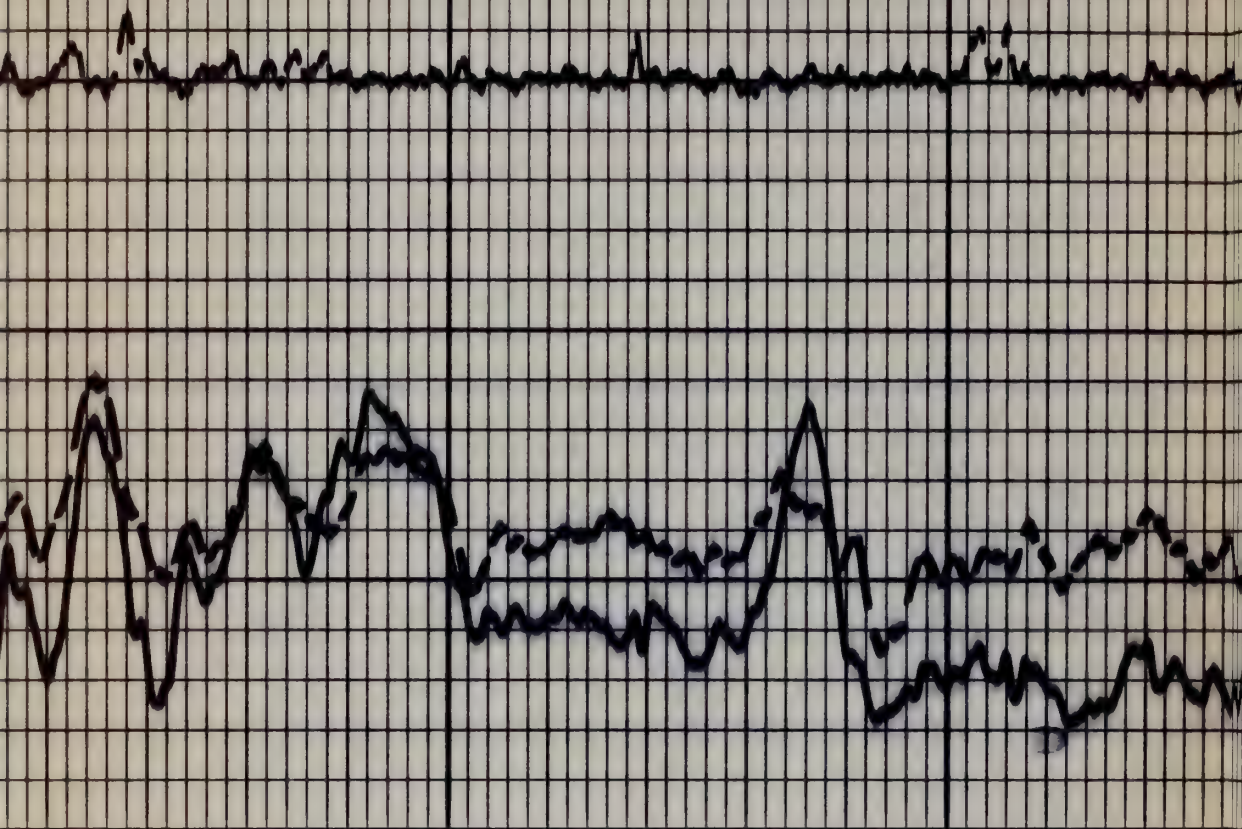
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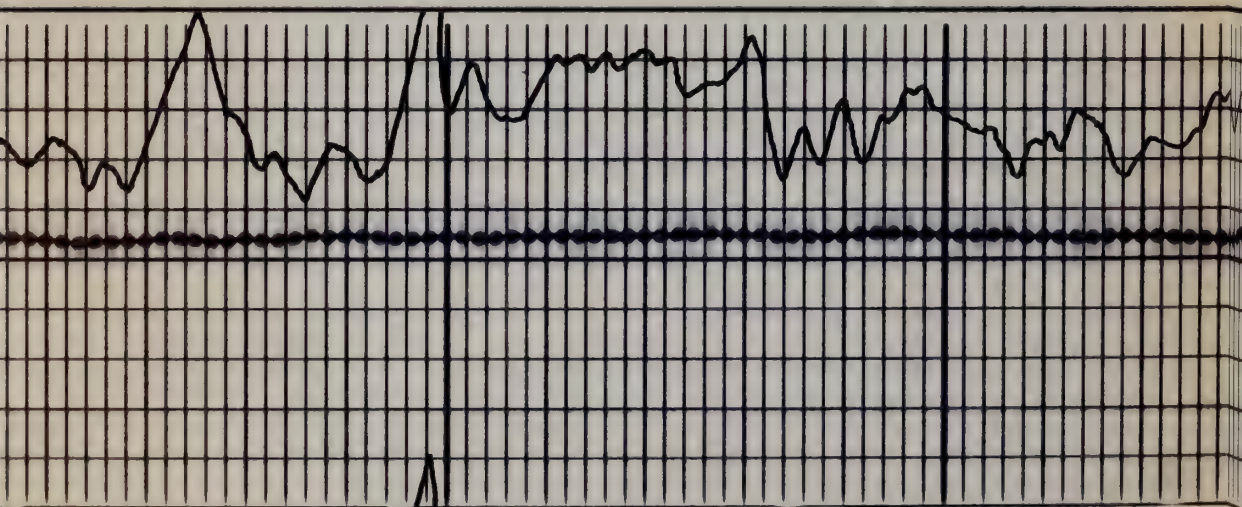


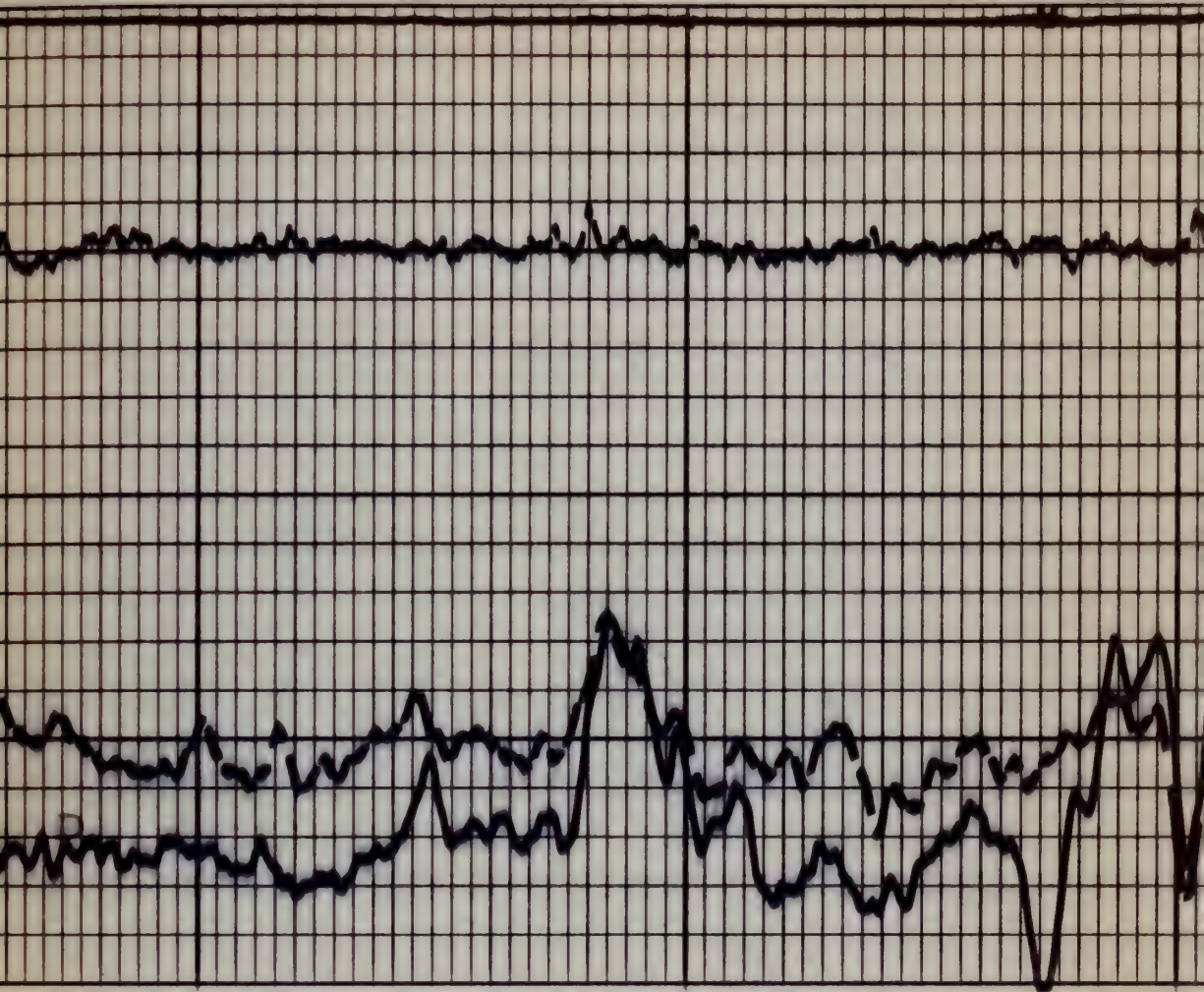
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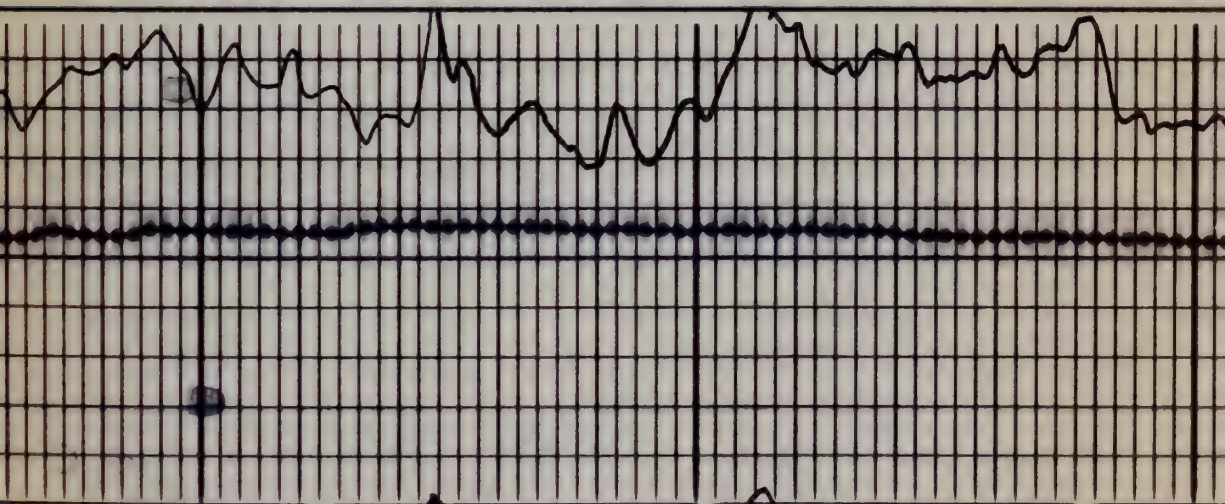
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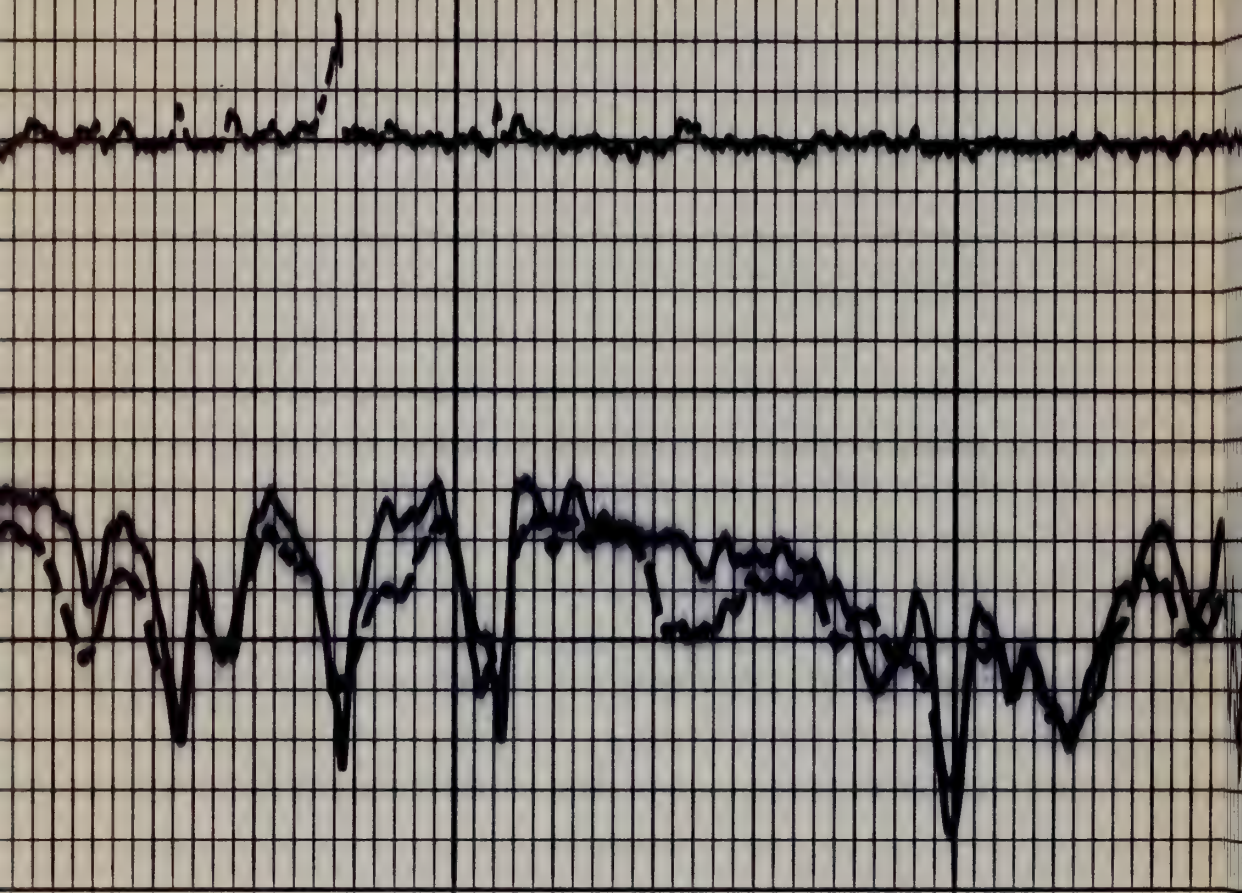




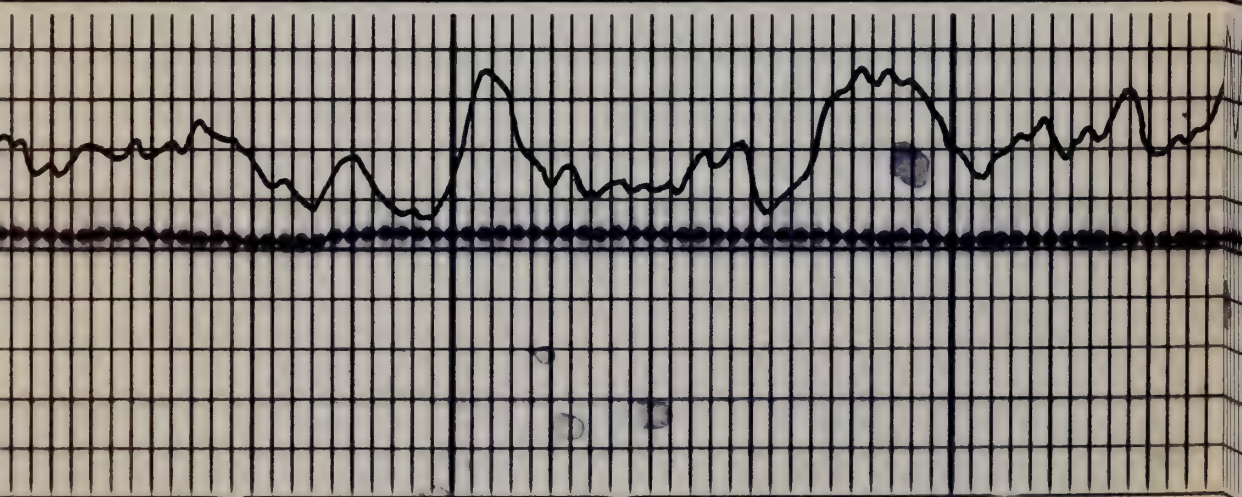
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0900

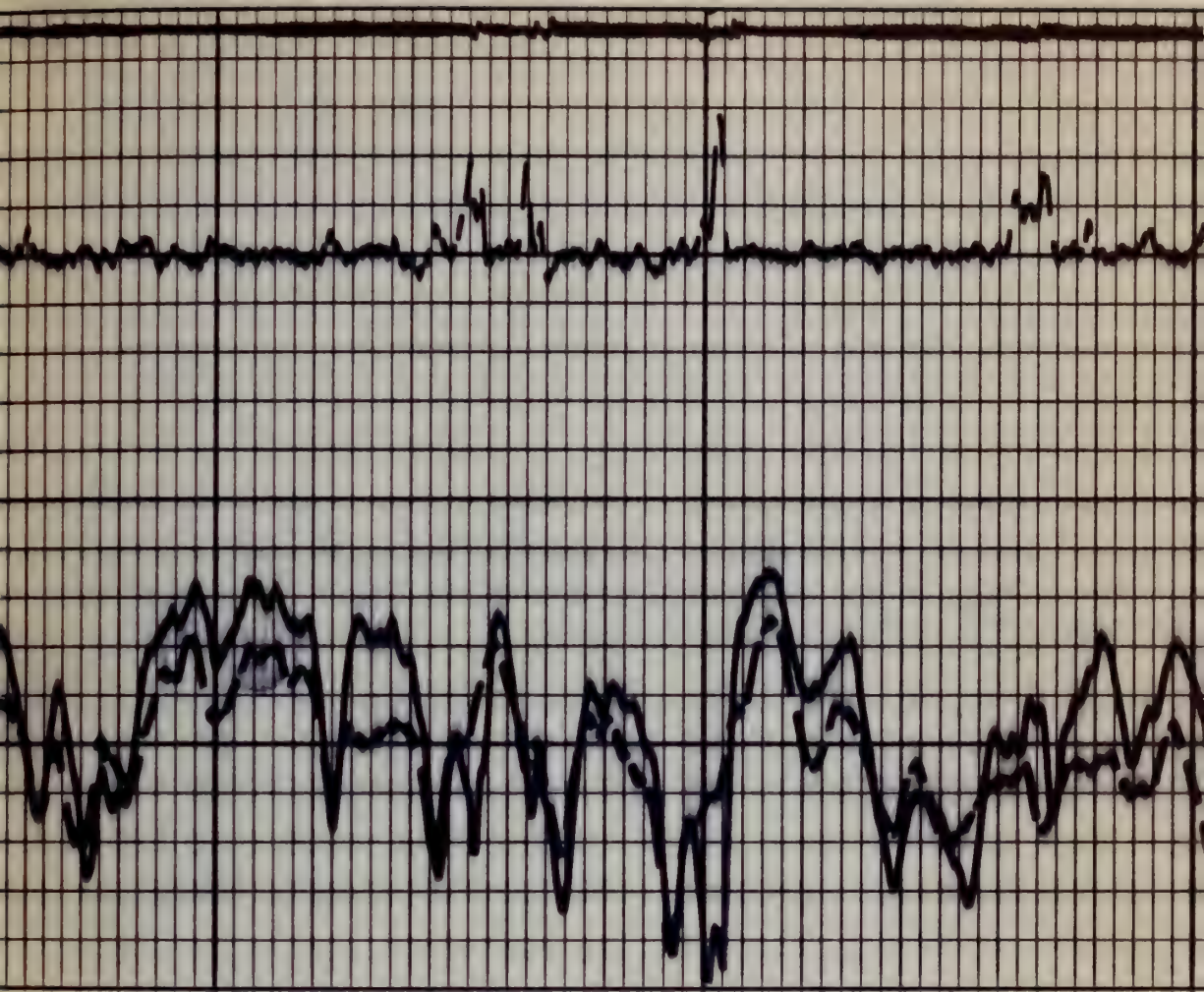




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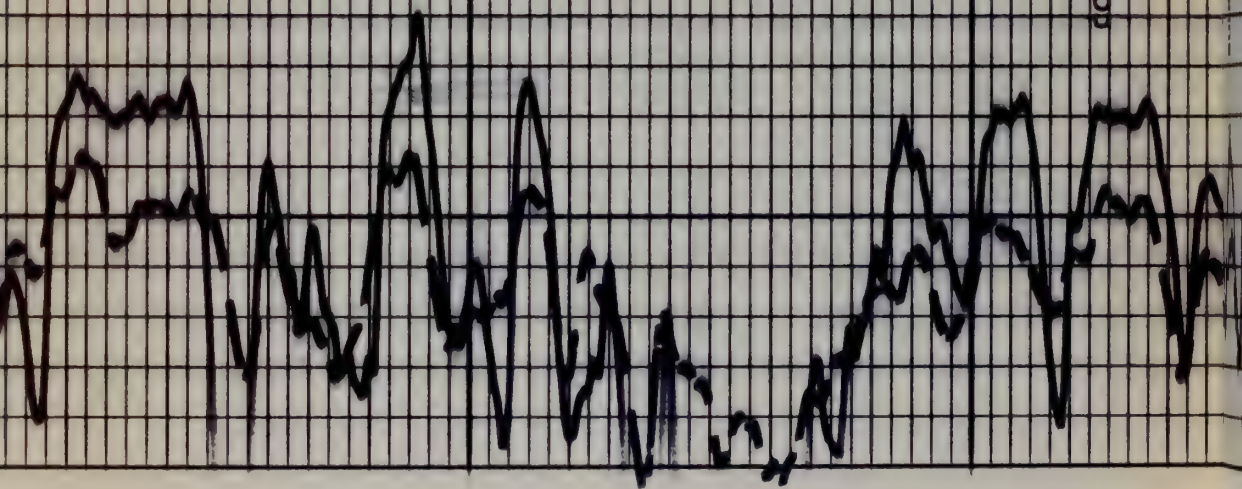
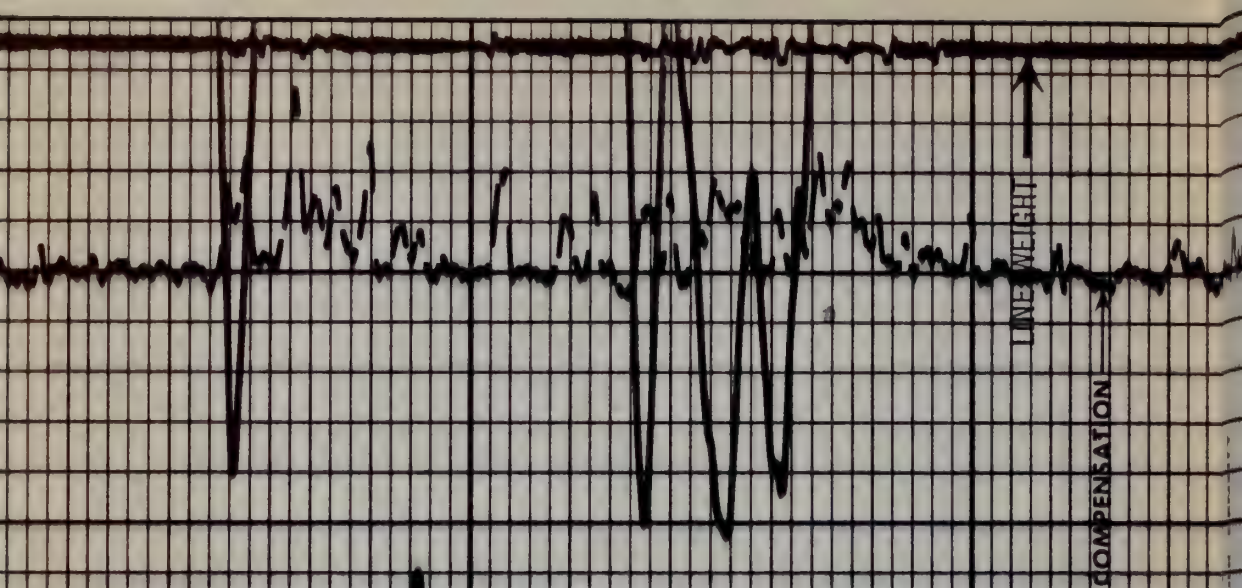


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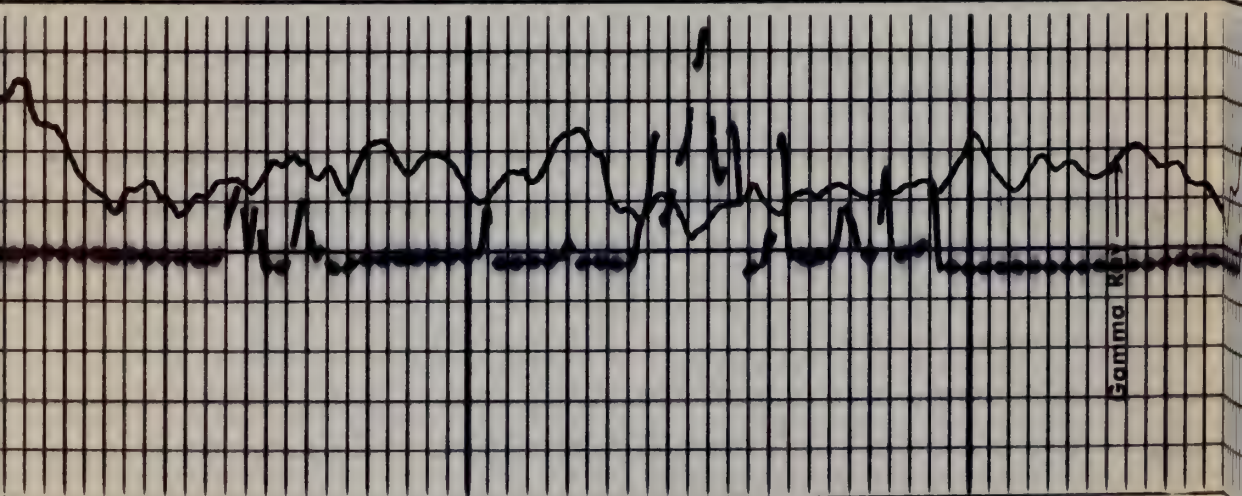


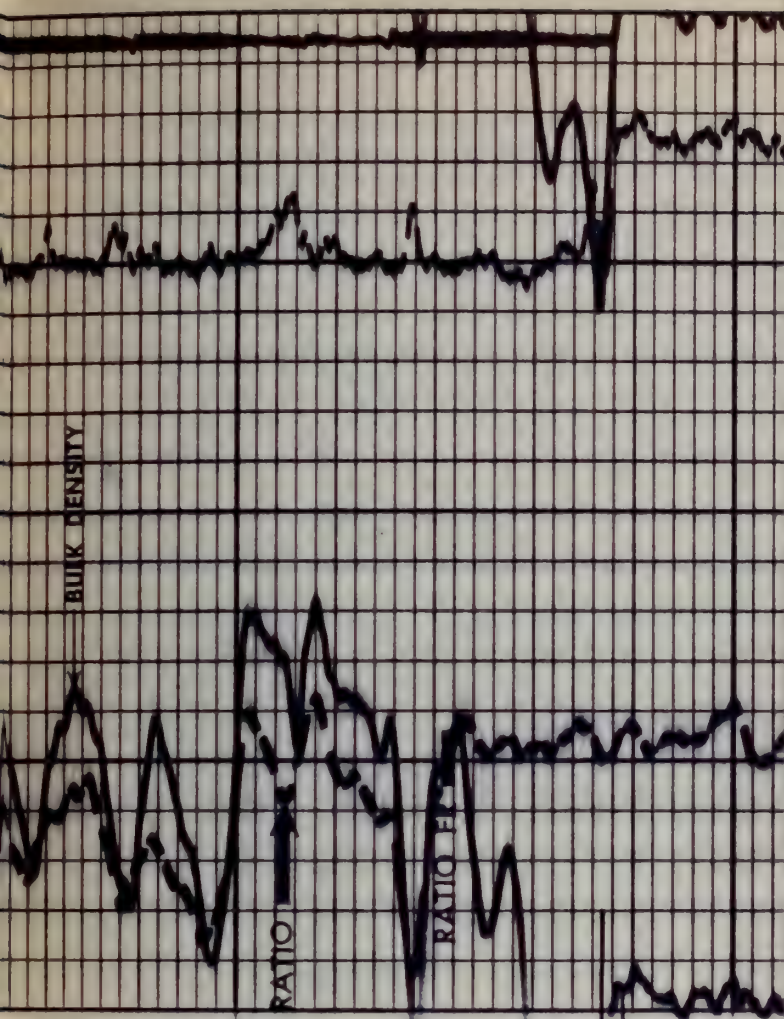
1100



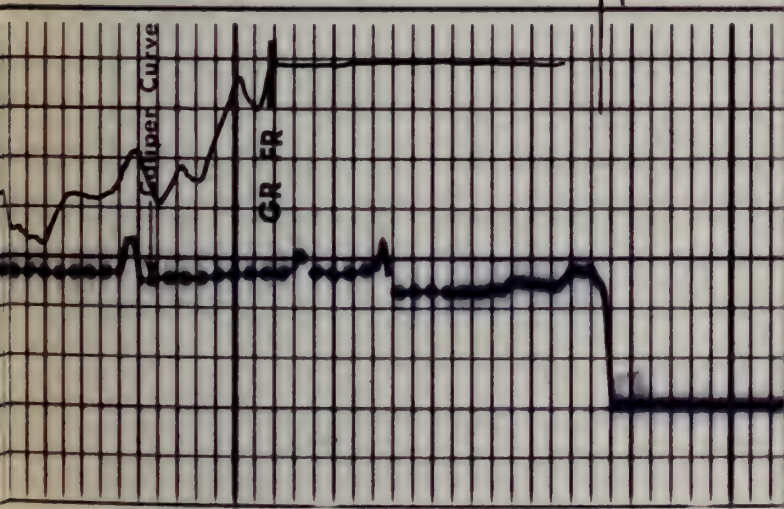


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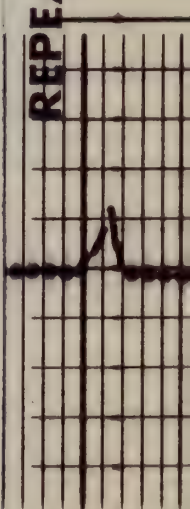


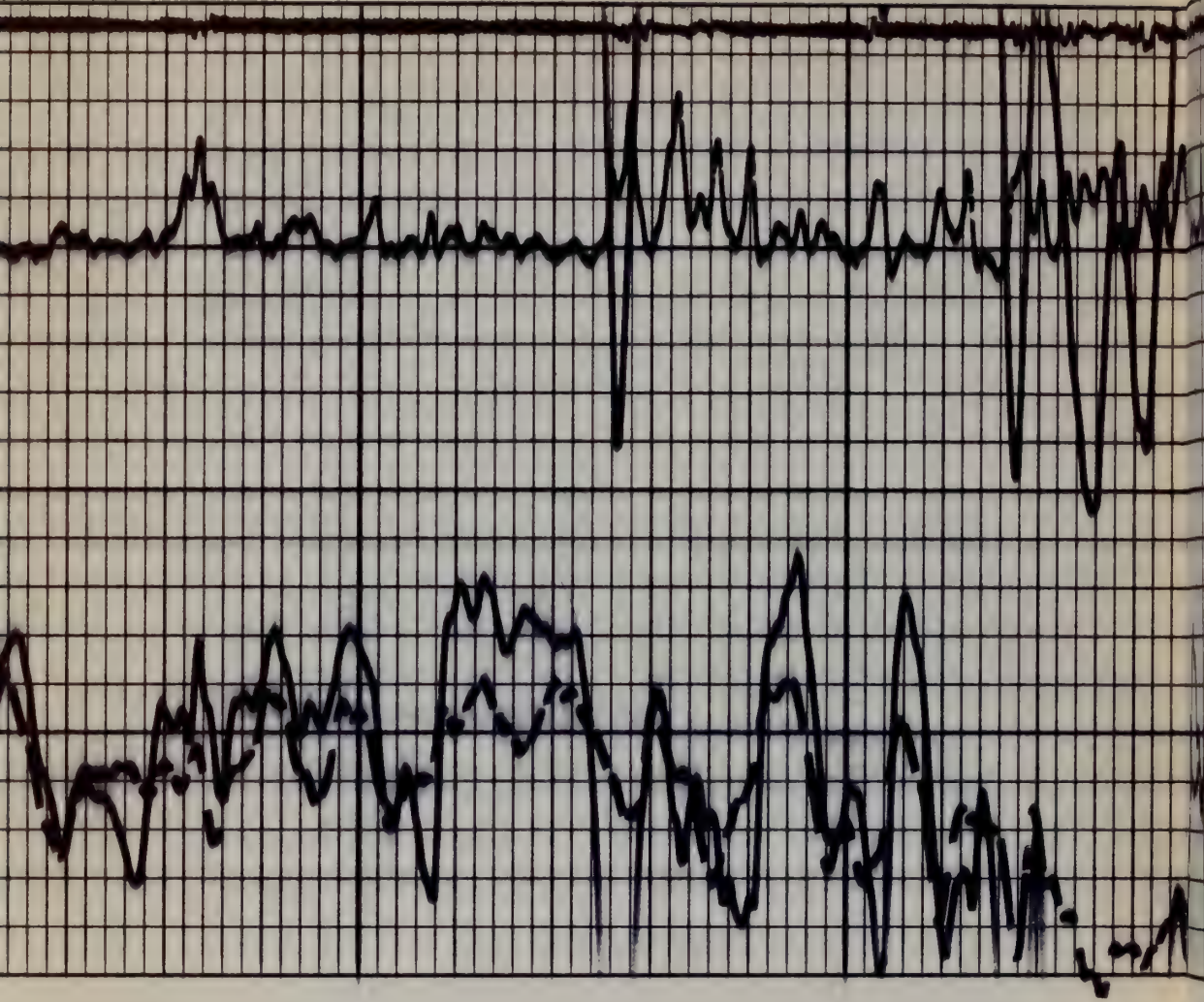


1300

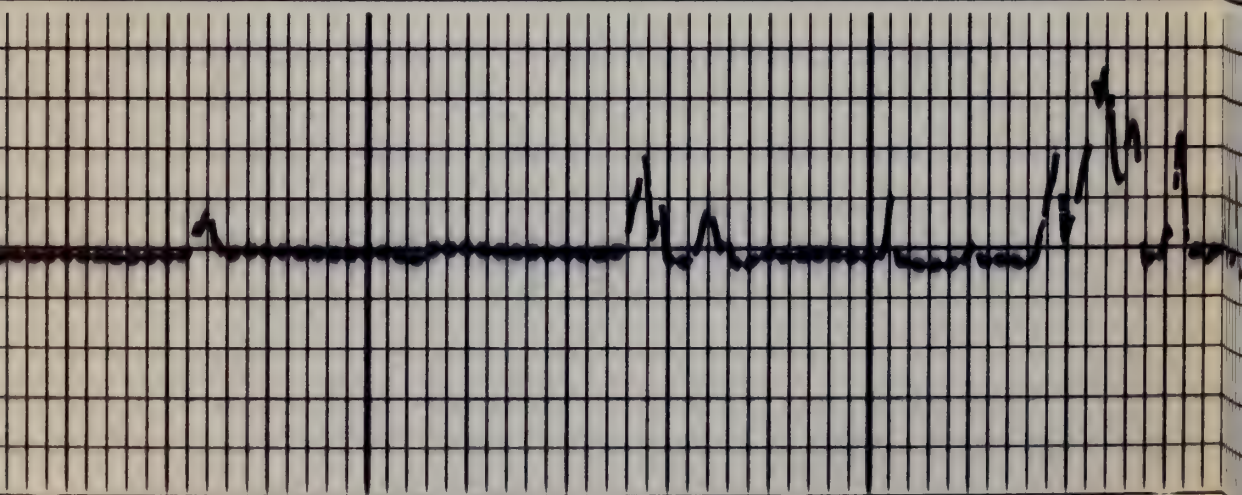


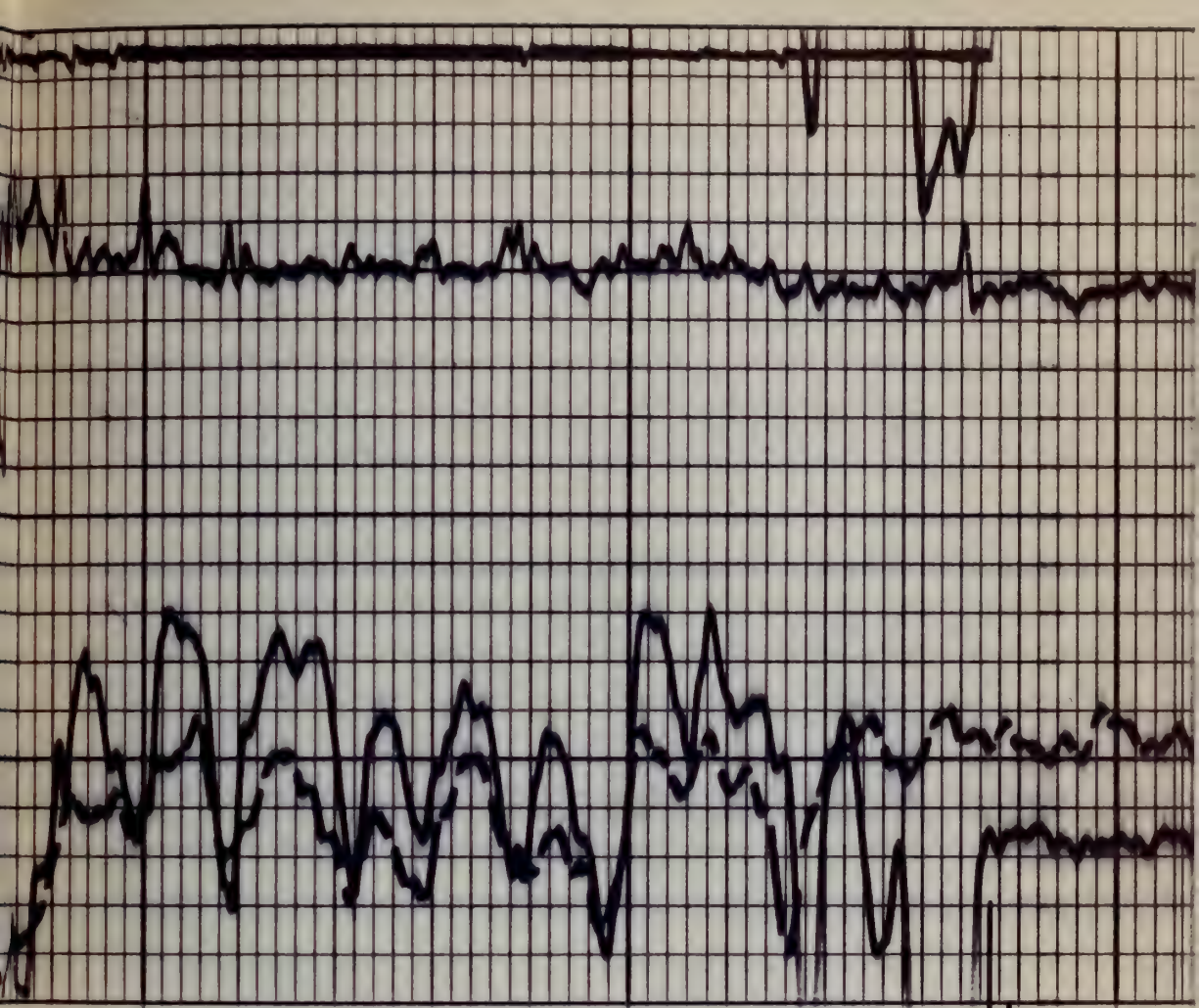
REPEAT SECTION
100



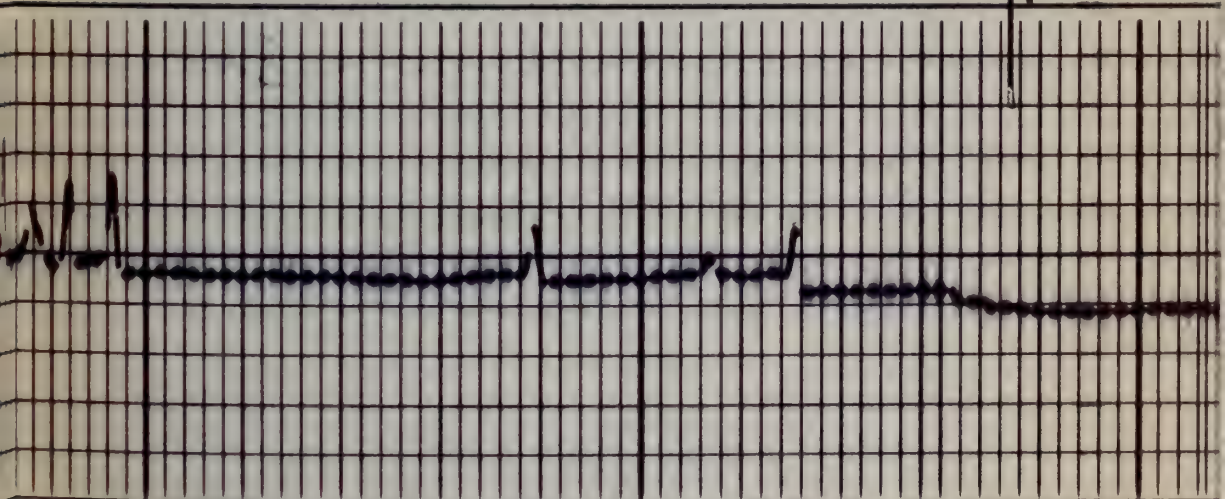


1200





1300



INCREMENTAL WEIGHT LINE	
0	2.0
150	2.5
	3.0
1.0	
1.5	
2.0	

BULK DENSITY	
GRAMS/CC.	

8	18
---	----

CORRECTION	
GRAMS/CC.	
- .25	
0	
+ .25	
RATIO	
2.5	
5.0	
0	

GAMMA RAY	
API UNITS	
0	150
150	300

CALIPER
HOLE DIAM. IN INCHES

DEPTHS

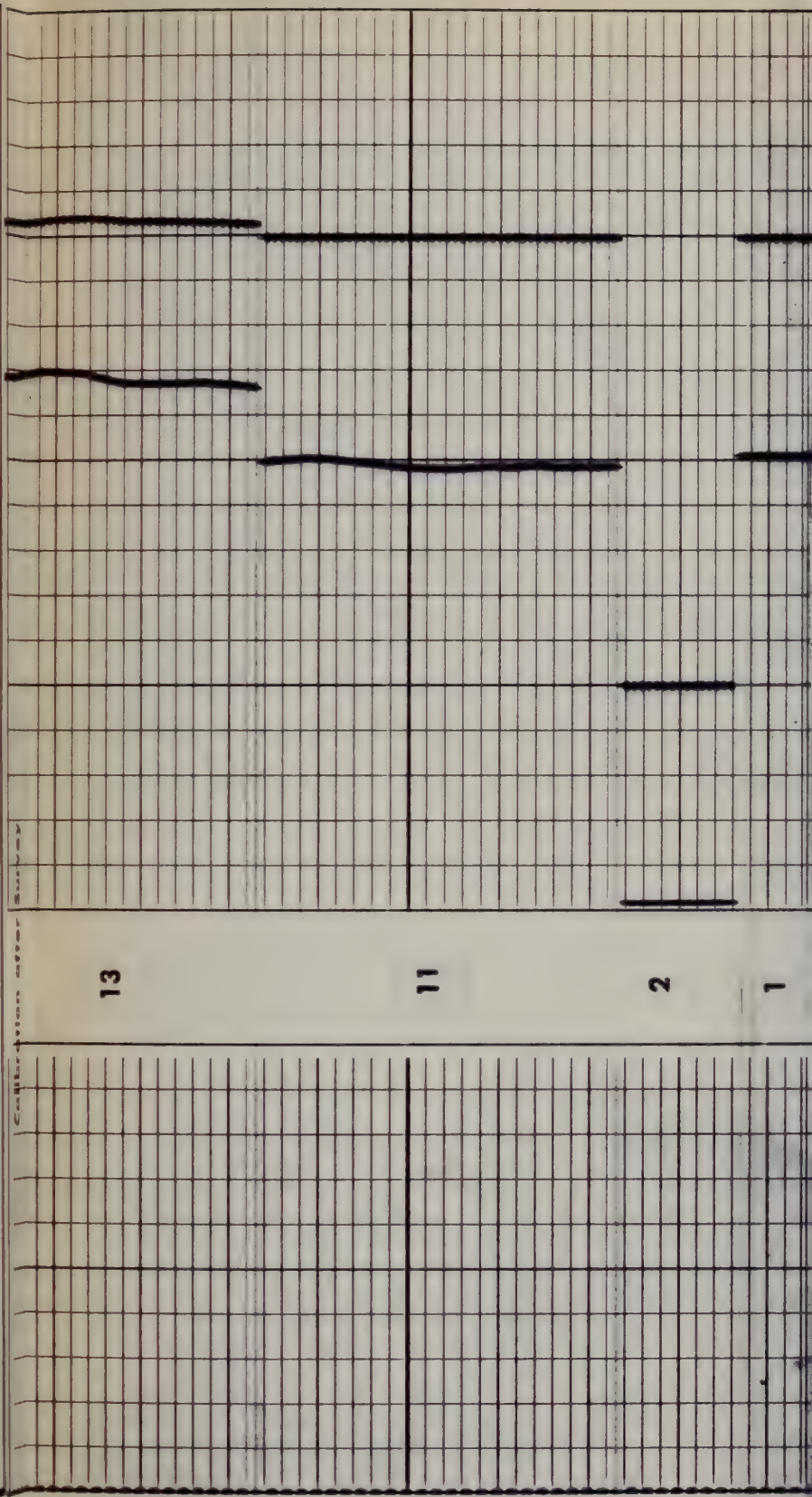
COMPANY	ATLANTIC RICHFIELD COMPANY
WELL	SORGUM GULCH AQUIFER NO. 1
FIELD	
COUNTY	RIO BLANCO
STATE	COLORADO

SCHL. FR	1337
SCHL. TD	1339
DRIL TD	1338
Elev:	
KB	----
DF	----
GL	6909

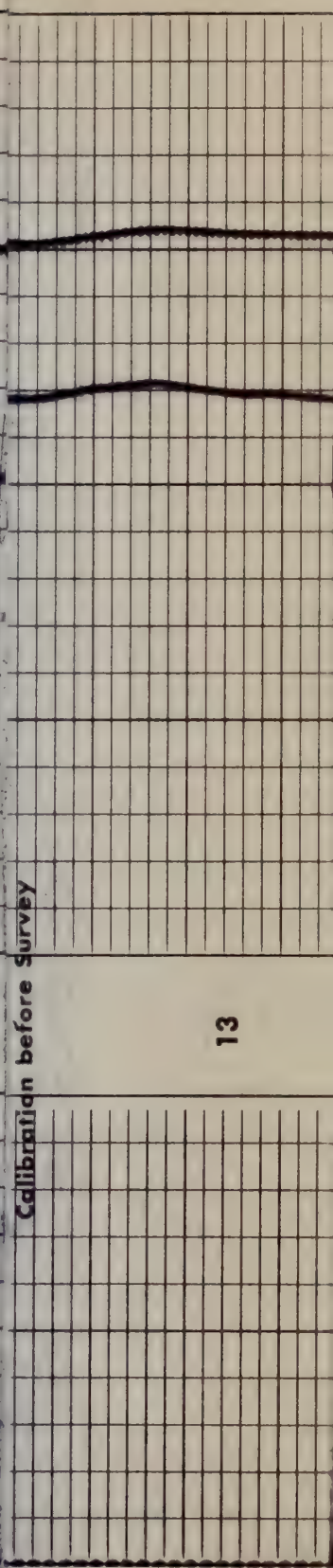
CALIBRATION RECORD

Calibration after	Survey
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CALIBRATION RECORD



Calibration before Survey



13

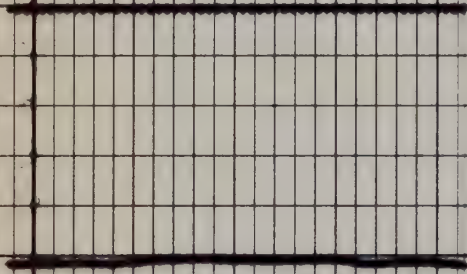
11

2

1

13

11



2



1



PANEL FUNCTION FORMER CHECKS

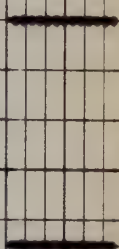
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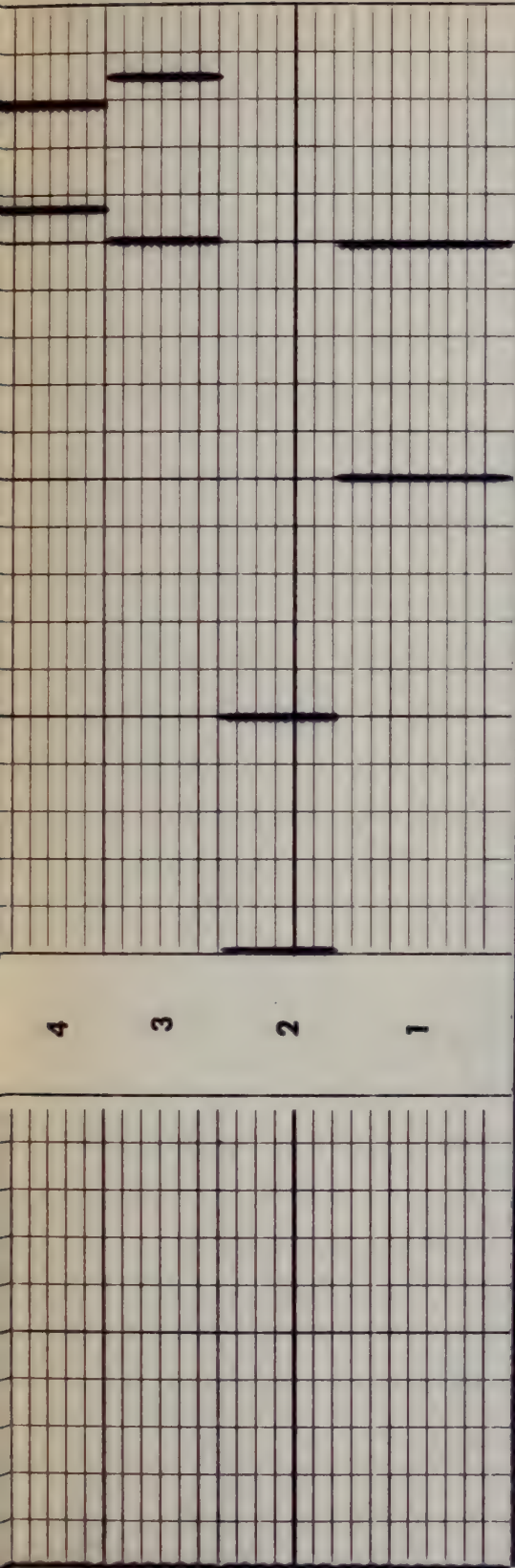


6



5





FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

POS	ρ	$\Delta\rho$
# 1	2.92	.00
# 2	2.78	+.14
# 3	2.42	-.10
# 4	2.35	.00
# 5	2.08	.01

MECHANICAL ZERO CALIPER

9. 8" RING
10. 12" RING
11. TOOL CALIBRATE # 1 SET $\rho = 2.50$
12. TOOL CALIBRATE # 2 SET $\Delta\rho = .00$
13. LOG POSITION $\rho = 2.59$, $\Delta\rho = .015$

- 1. MECHANICAL ZERO
- 2. ELECTRICAL ZERO
- 3. RECORDER SENSITIVITY
- 4. MEMORIZER ADJUSTMENT
- 5. BACKGROUND
- 6. CALIBRATE - SOURCE IN PLACE



CALIBRATION RECORD

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1337

SCHL. TD 1339

DRLR TD 1338

Elev: KB ----

DF ----

GL 6909

Schlumberger

COMPENSATED NEUTRON-
FORMATION DENSITY

COUNTY **RIO BLANCO**
FIELD or LOCATION
WELL **SORGUM GULCH**
AQUIFER NO. **1**
COMPANY **ATLANTIC RICHFIELD**

COMPANY **ATLANTIC RICHFIELD COMPANY**WELL **SORGUM GULCH AQUIFER NO. 1**

FIELD

COUNTY **RIO BLANCO** STATE **COLORADO**Location: API Serial No. **07174**Sec. **7** Twp. **3S** Rge. **96W**

Other Services:

DIL TEMP.
FDC-GR
BHC-GR

Permanent Datum: **GL**; Elev.: **6909**
Log Measured From **GL**, **0** Ft. Above Perm. Datum
Drilling Measured From **GL**

Elev.: K.B. **----**
D.F. **----**
G.L. **6909**

Date	7-5-74					
Run No.	ONE					
Depth—Driller	1338					
Depth—Logger	1339					
Btm. Log Interval	1337					
Top Log Interval	162					
Casing—Driller	13-3/8@166			@	@	@
Casing—Logger	162					
Bit Size	12-1/4					
Type Fluid in Hole	WATER					
Fluid Level	410					
Dens.	Visc.					
pH	Fluid Los	ml	ml	ml	ml	ml
Source of Sample						
R _{mm} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mf} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mc} @ Meas. Temp.	@	°F	@	°F	@	°F
Source: R _{mf}	R _{mc}					
R _m @ BHT	@	°F	@	°F	@	°F
Time Since Circ.						
Max. Rec. Temp.	68	°F	°F	°F	°F	°F
Equip.	7674 VERNAL					
Recorded By	HAUGAARD					
Witnessed By	TATE					

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES			
Date	Sample No.		
Depth - Driller			
Type Fluid			
Source of Sample			
Rm @ Meas. Temp.	@	°F	@ °F
Rmf @ Meas. Temp.	@	°F	@ °F
Rmc @ Meas. Temp.	@	°F	
Rm @ BHT	@	°F	
Dens.	Visc.		
ph	Fluid Loss	ml	ml
% Water by Vol.			
% Oil by Vol.			
% Solids by Vol.			
Solids Av. Sp. Gr.			

EQUIPMENT DATA			
Run No.	ONE		
Dens. Pnl.	EA-355		
Dens. Cart	EA-263		
Dens. Skid	D-1095		
Dens. Sde	E-235		
Dens. Source	2940		
Dens. Calib.	545		
Neut. Pnl.	A-27		
Neut. Cart	A-26		
Neut. Source	185		
Neut. Calib	A-126		
GR Cart	J-98		
TTR	----		
Mem Pnl.	A-173		

BIT SIZE/CASING DATA			
Bit	Fram	To	Csg. Size
12	1338	166	13-
		166	SURF.

SCALE CHANGES			
Type Log	Depth	Scale Up Hole	Scale Down Hole

LOGGING DATA				
CNP				
Matrix	Auto Hole Size Corr.	Hole Size Setting (if not auto)	Porosity Scale	To
SAND	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		30/TK	CSG
	<input type="checkbox"/> Yes <input type="checkbox"/> No			
	<input type="checkbox"/> Yes <input type="checkbox"/> No			
	<input type="checkbox"/> Yes <input type="checkbox"/> No			
	<input type="checkbox"/> Yes <input type="checkbox"/> No			

FDC				
Liquid Density	Grain Density	Hole Fluid	Porosity Scale	To
1.00	2.65	LIQUID	30/TK	CSG

REMARKS	
Service Order No. -	SO #07174

1/4

3/4

CALIBRATION DATA

Run No.	Gamma Ray			CNL—Before Log—ACPS		CNL—After Log—ACPS	
	API Scale	Background CPS	Total CPS	Long Spacing	Short Spacing	Long Spacing	Short Spacing
1	0-200	100	500	408	912	408	912
2							
3							
4							
				FDC — Before Log — ACPS		FDC — After Log — ACPS	
1				P ₁	P ₂	P ₁	P ₂
2				416	688	416	688
3							
4							

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

DETAIL LOG

5" = 100'

CALIPER HOLE DIAM. IN INCHES	DEPTHS	DENSITY POROSITY INDEX %				
		SANDSTONE <small>MATRIX</small>				
8	18	60	45	30	15	0

GAMMA RAY

API UNITS

0

150

150

300

NEUTRON POROSITY INDEX %

SANDSTONE MATRIX

60

45

30

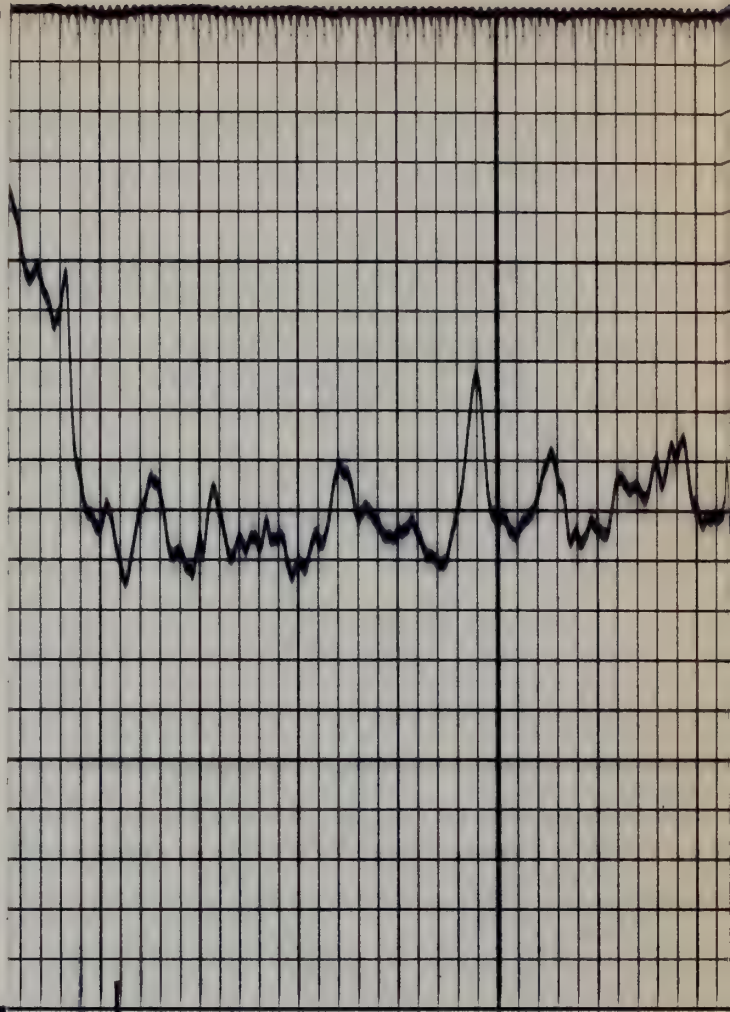
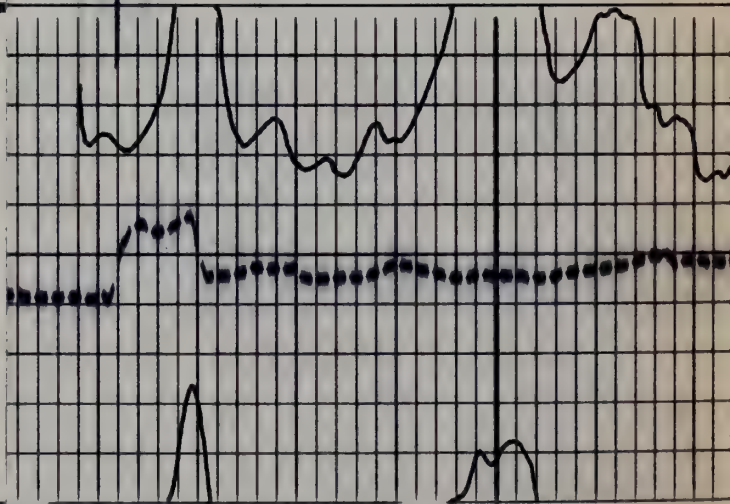
15

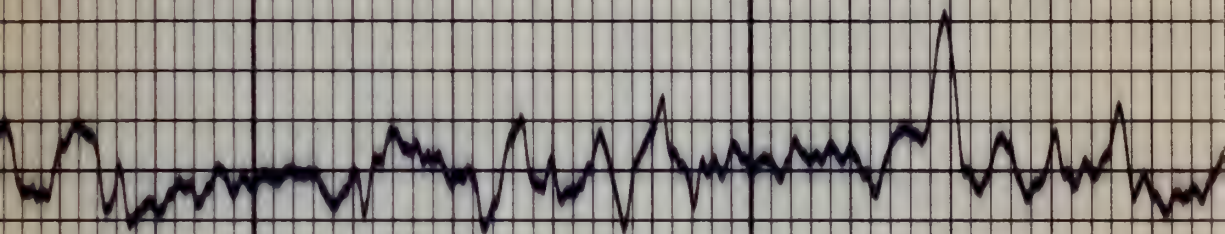
0

INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.

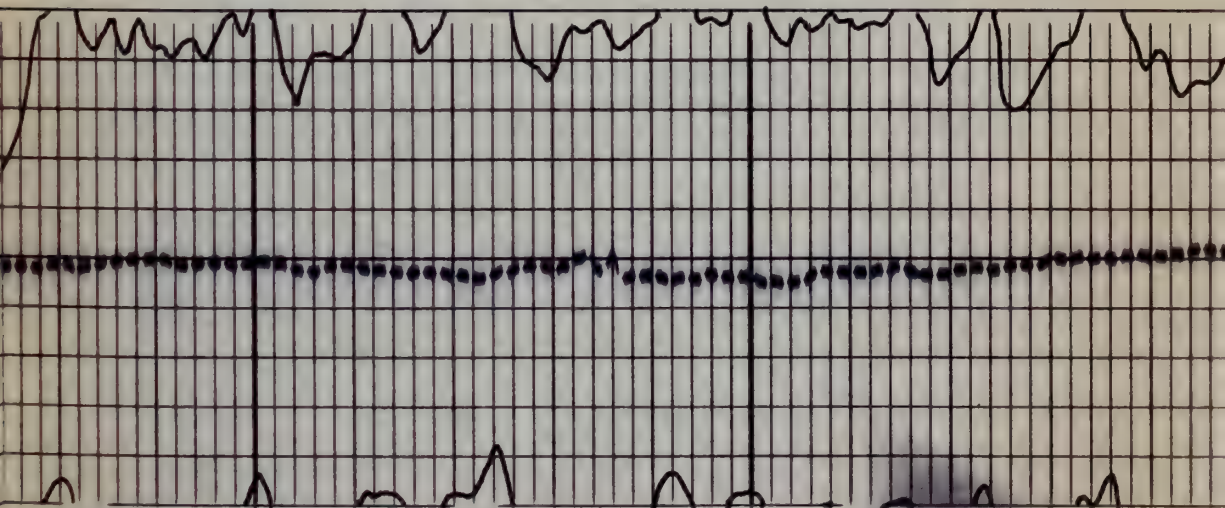
Casing

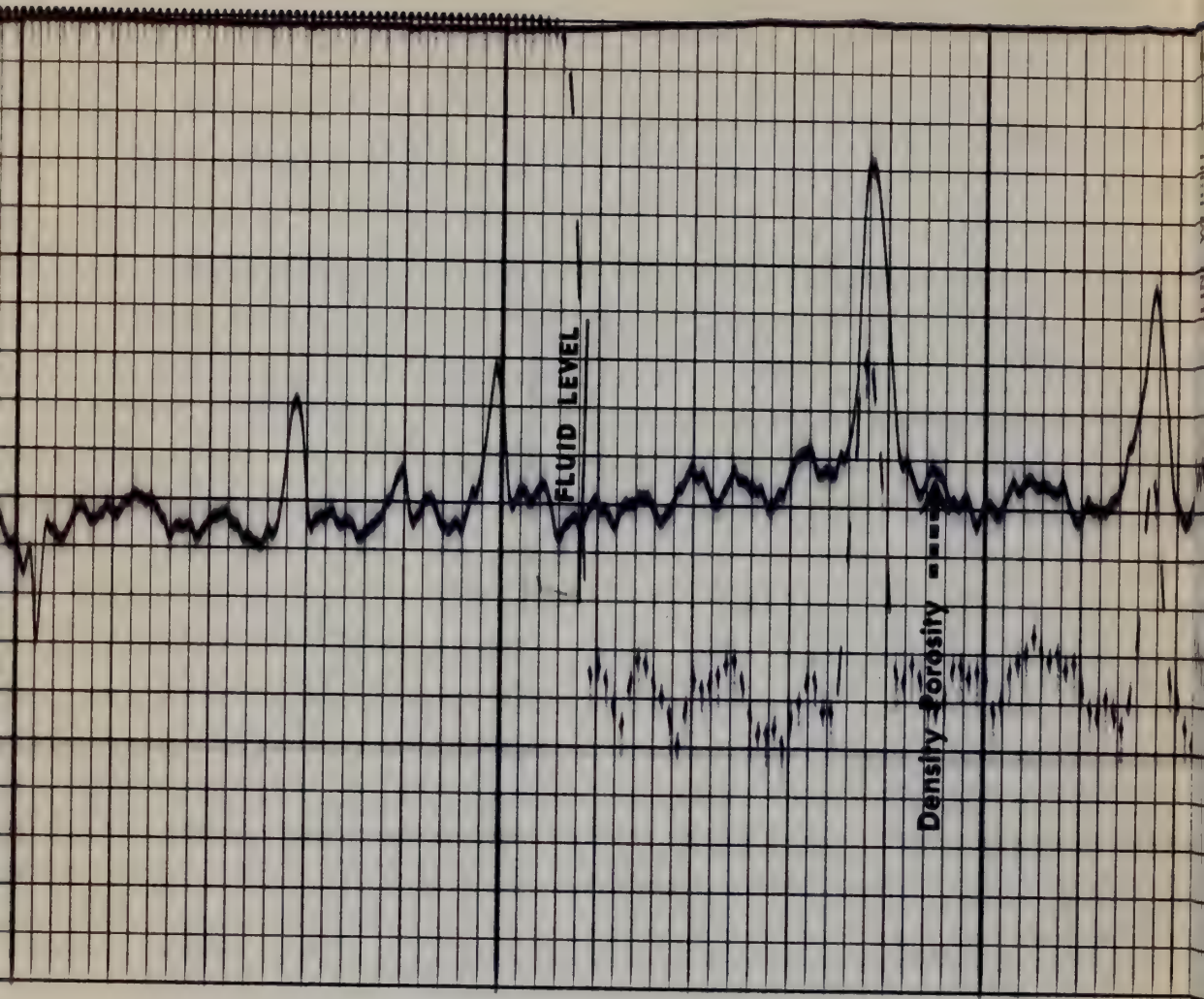
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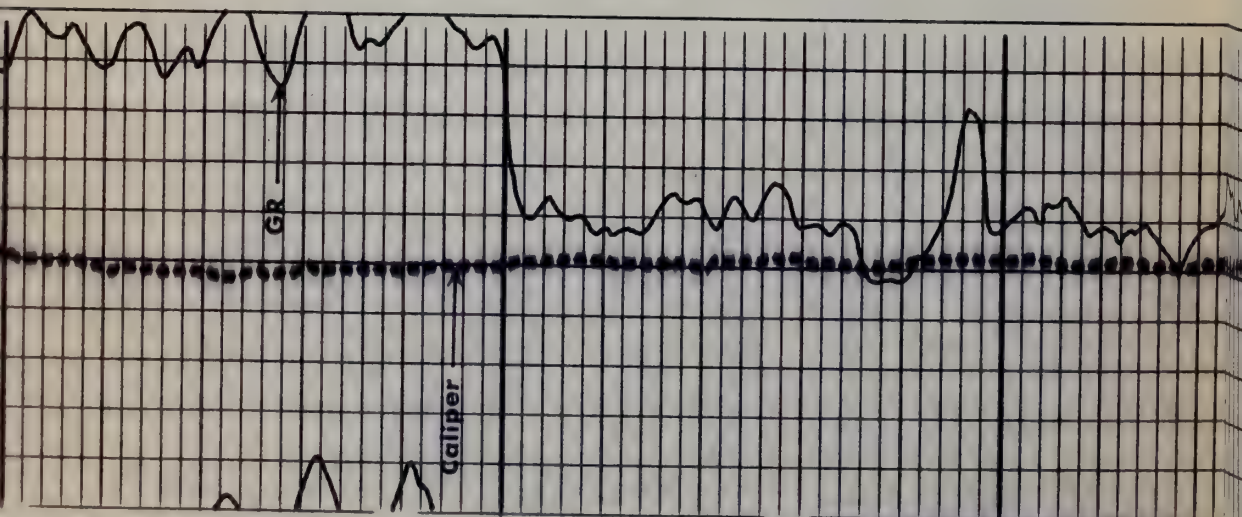


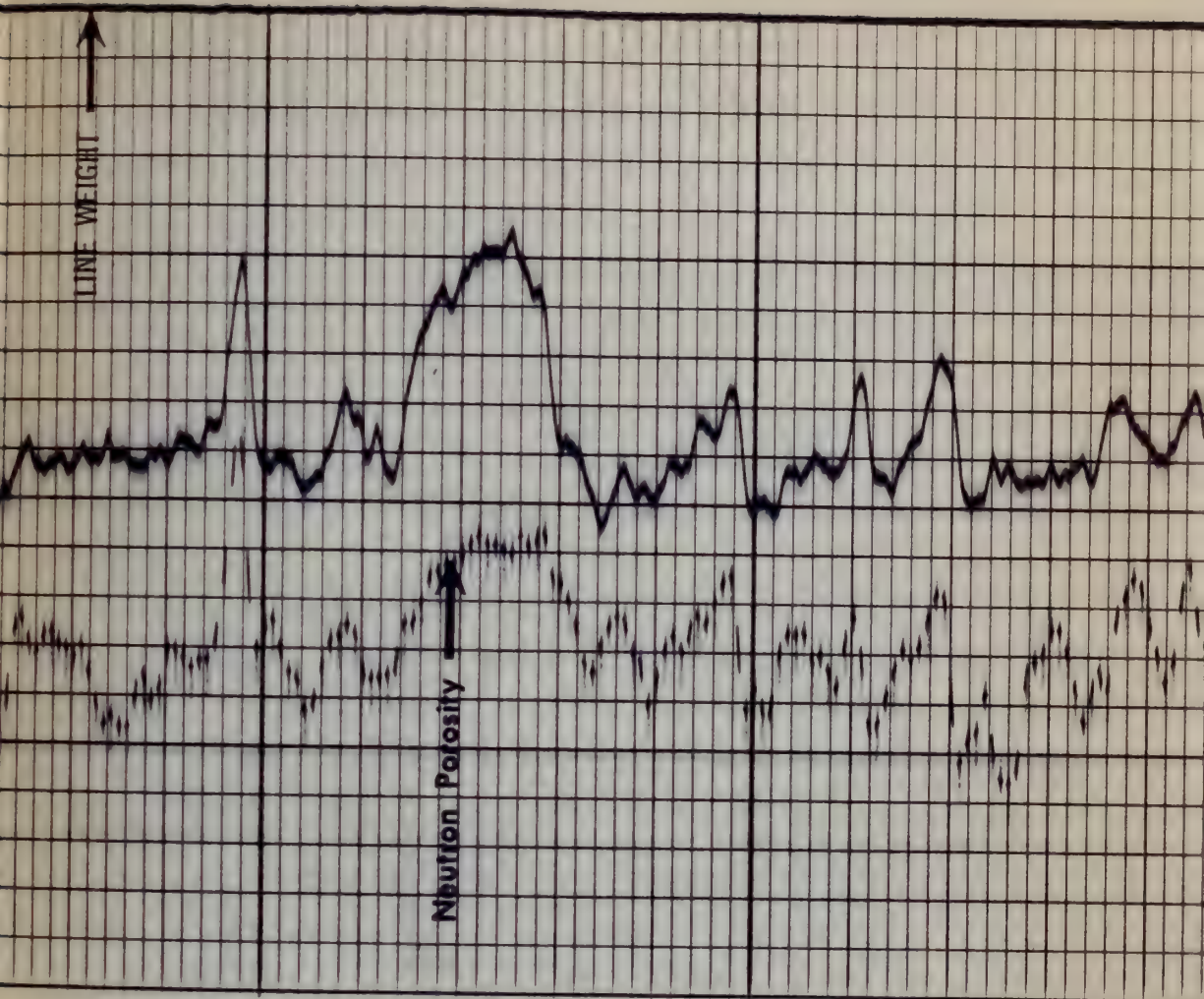
0300



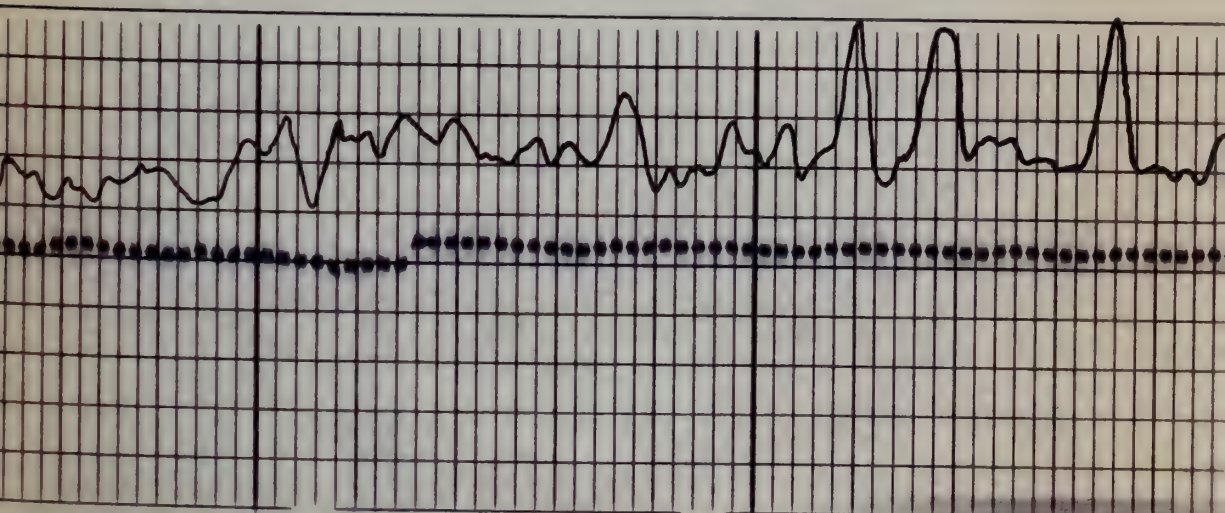


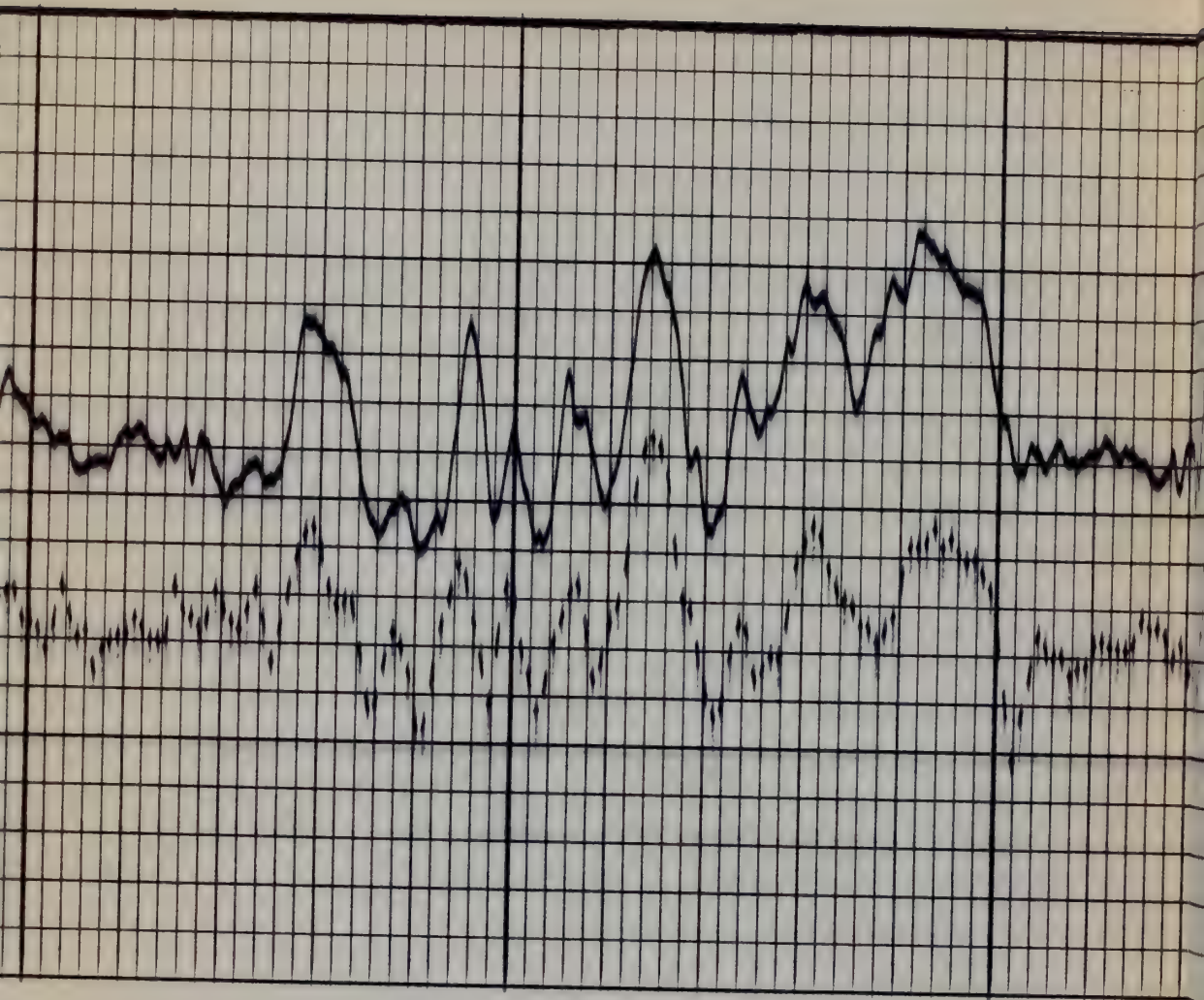
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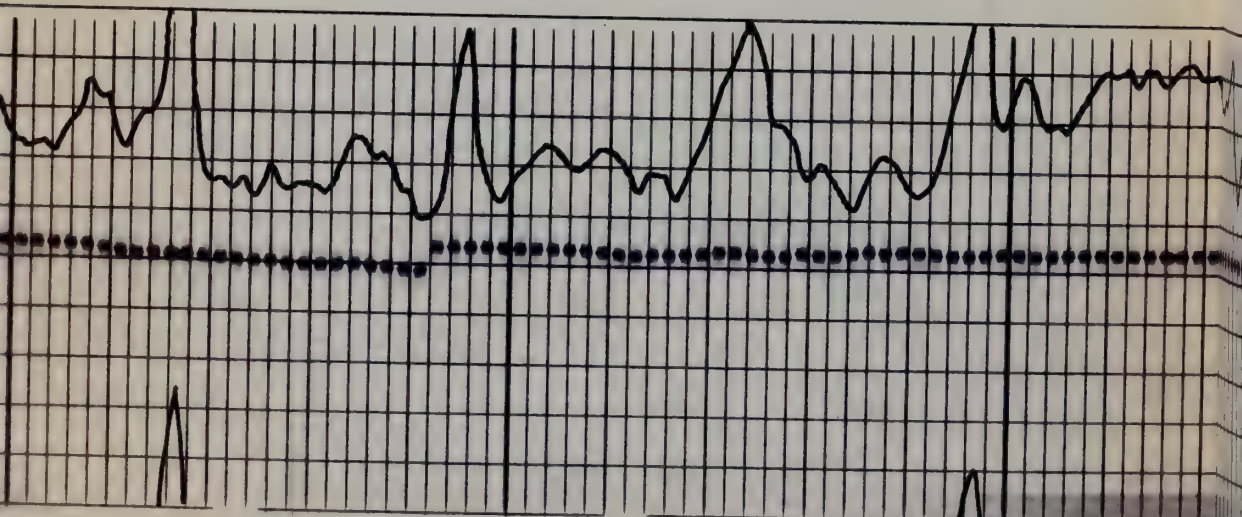
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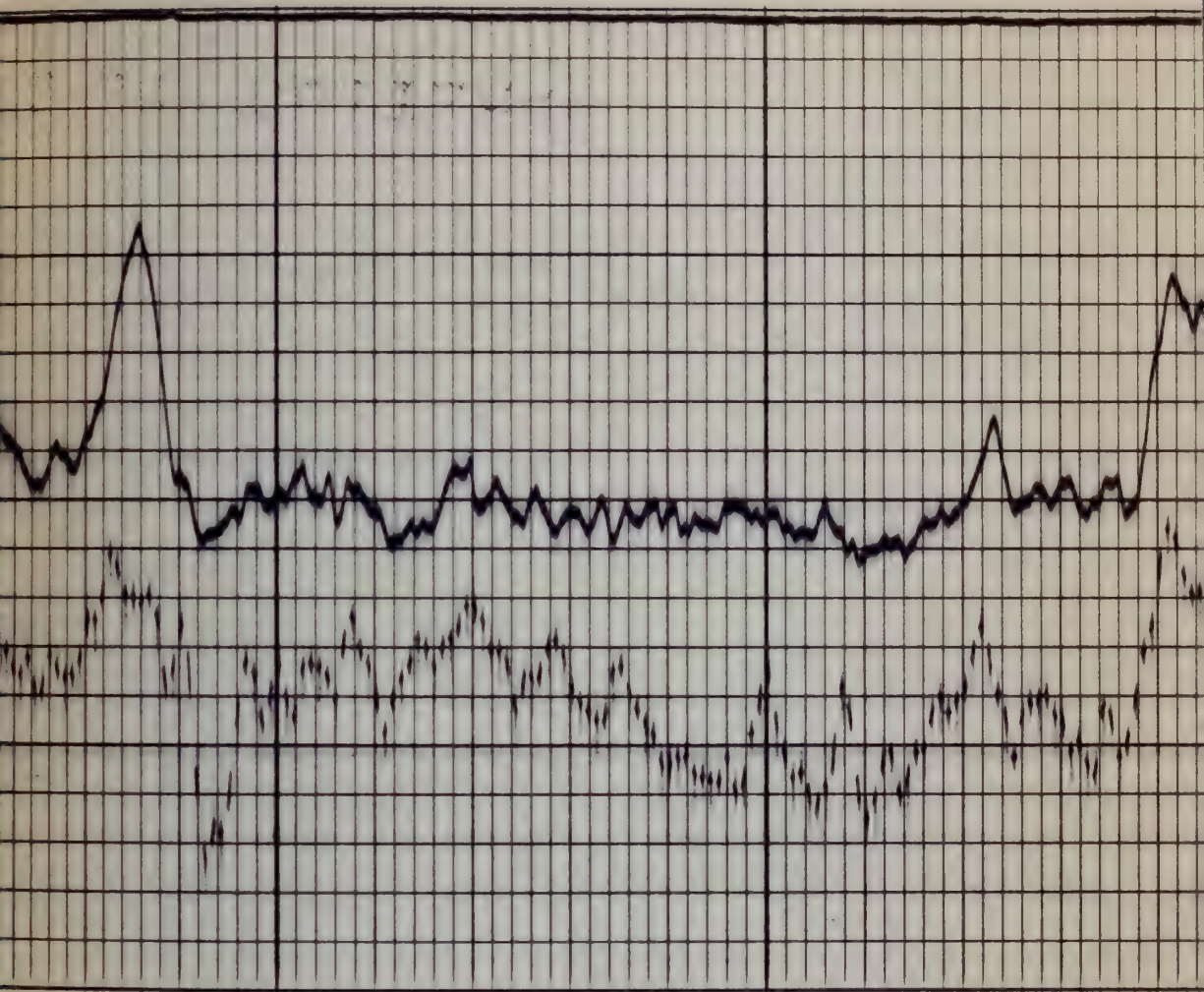




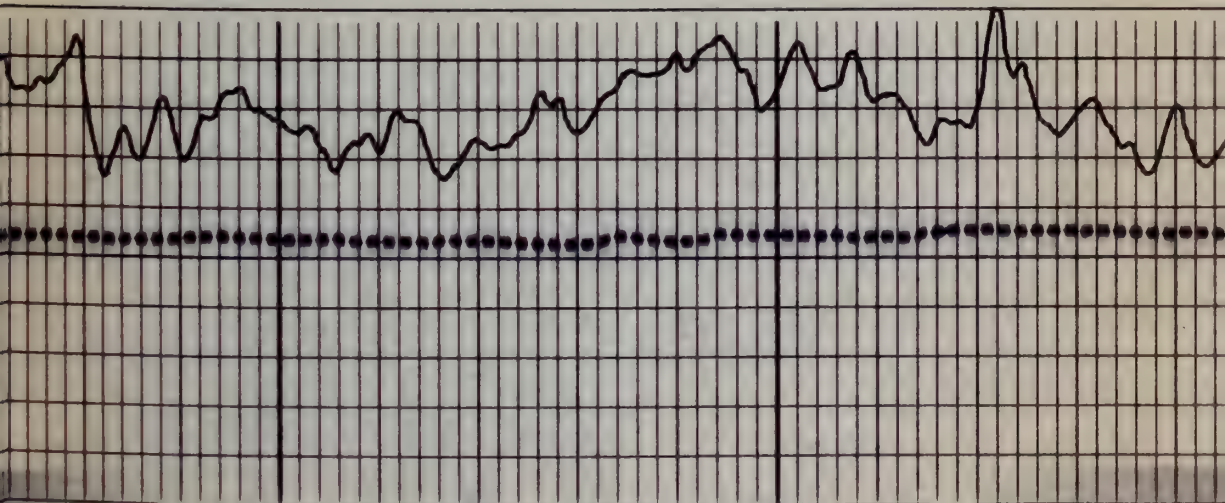
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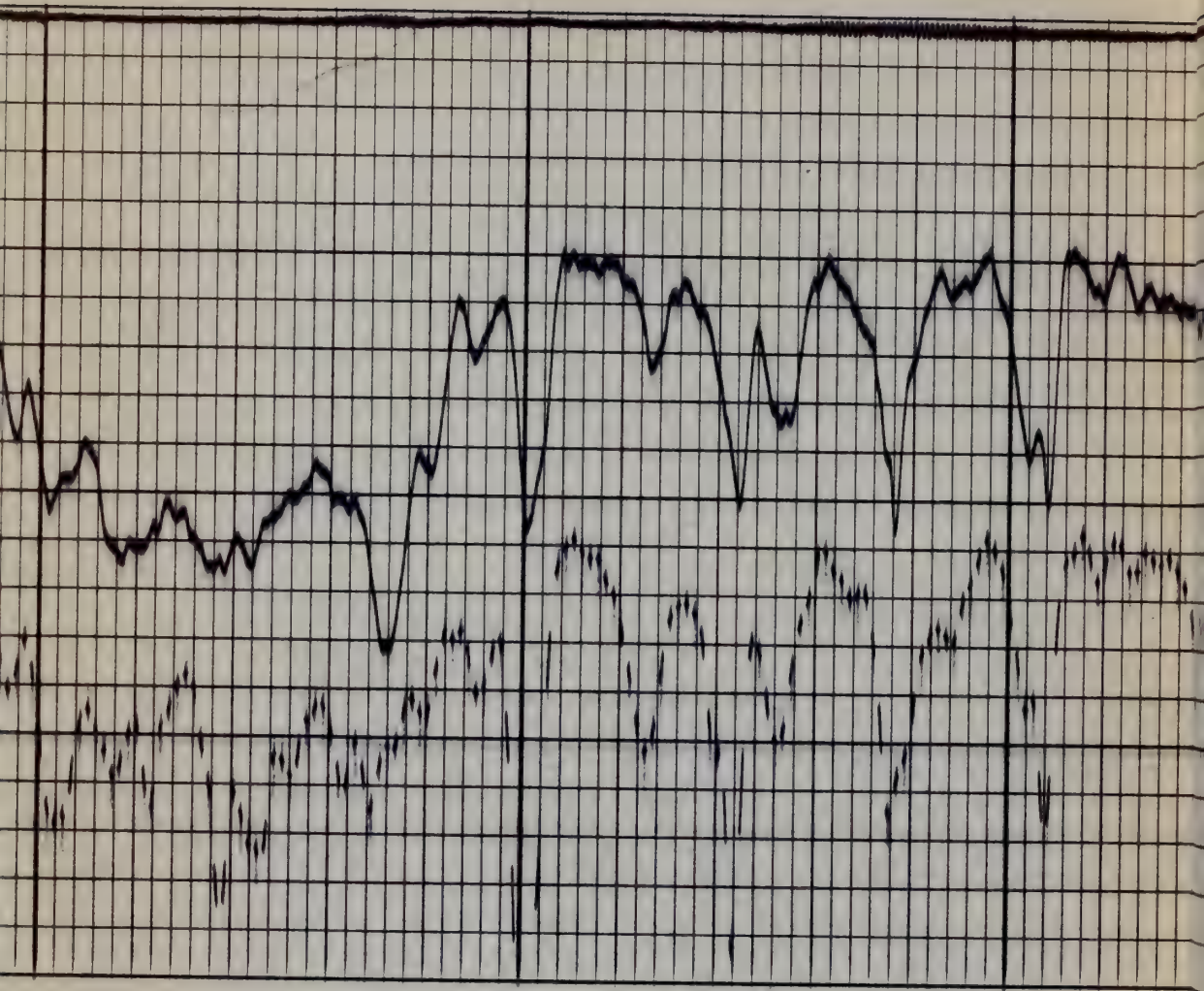
0700



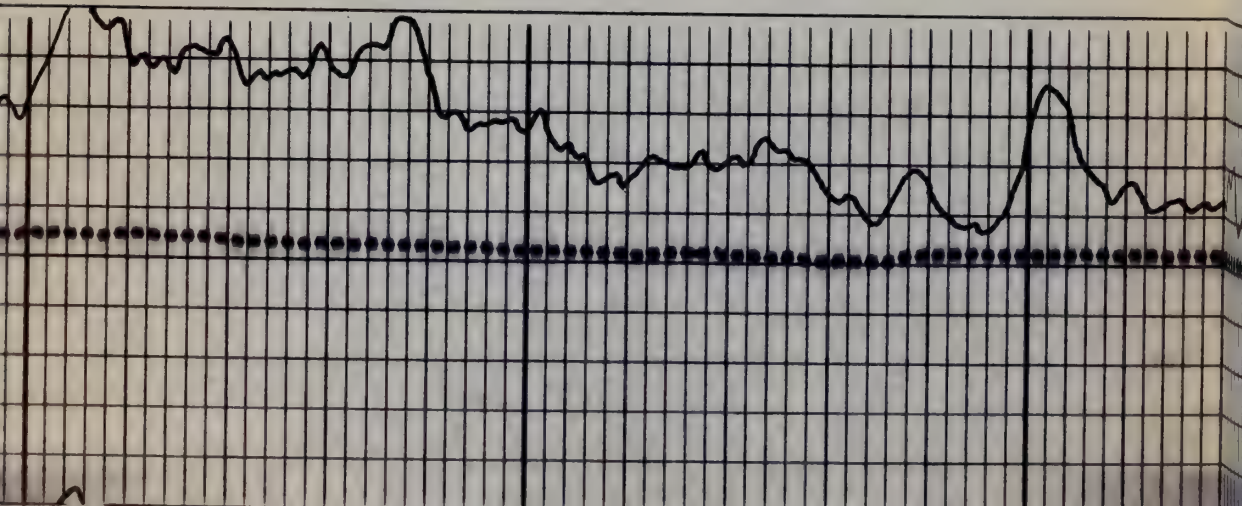


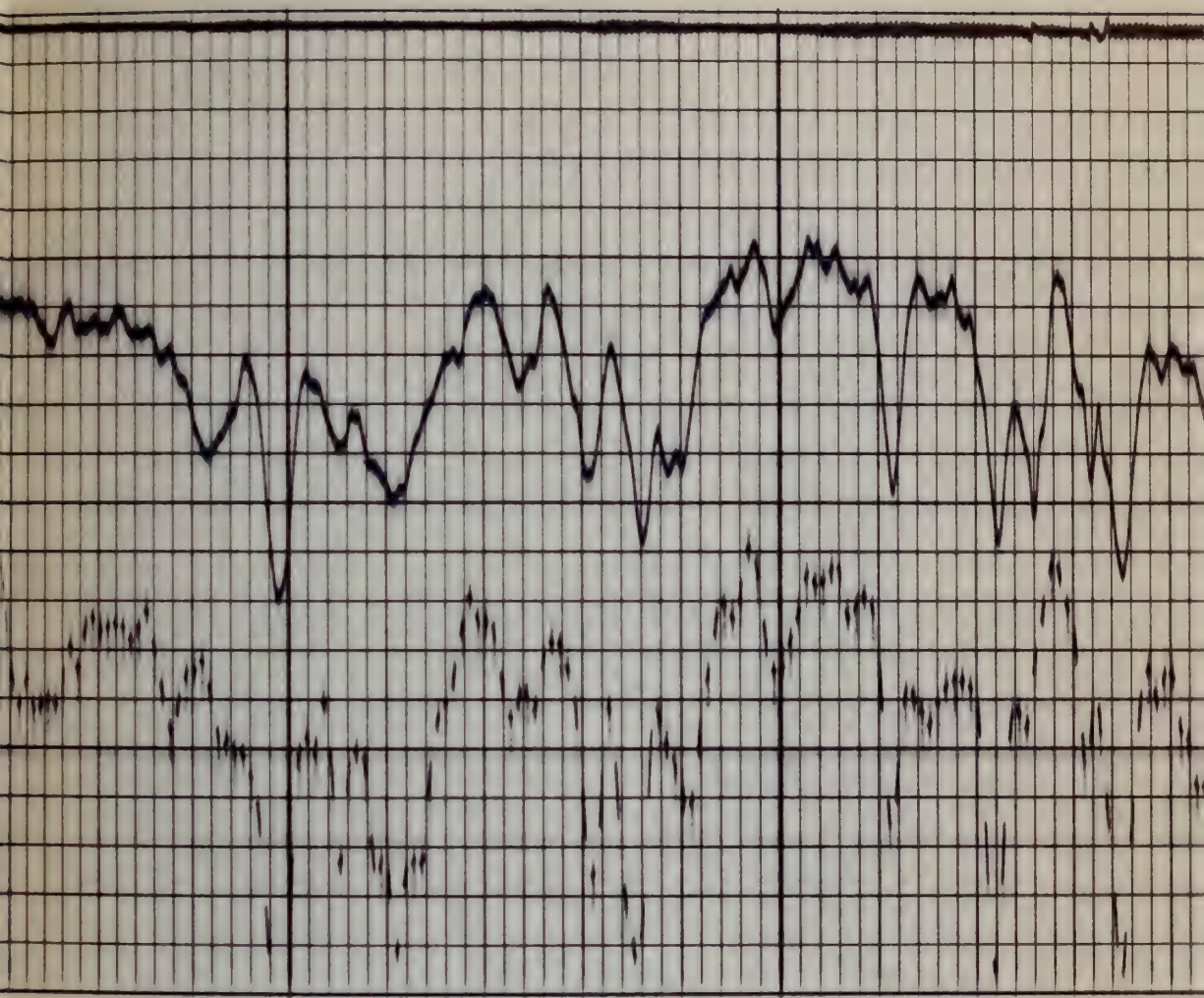
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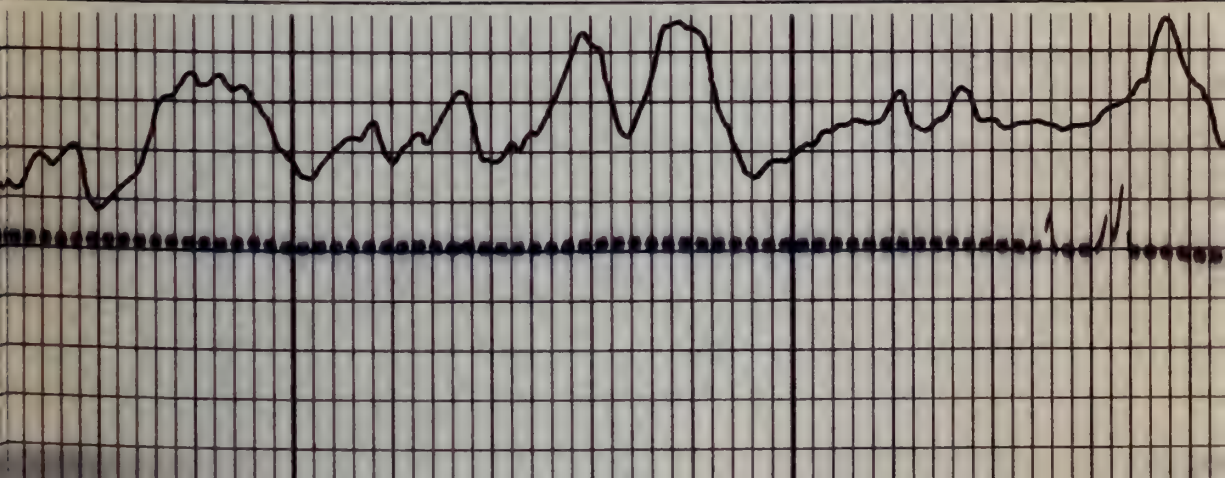


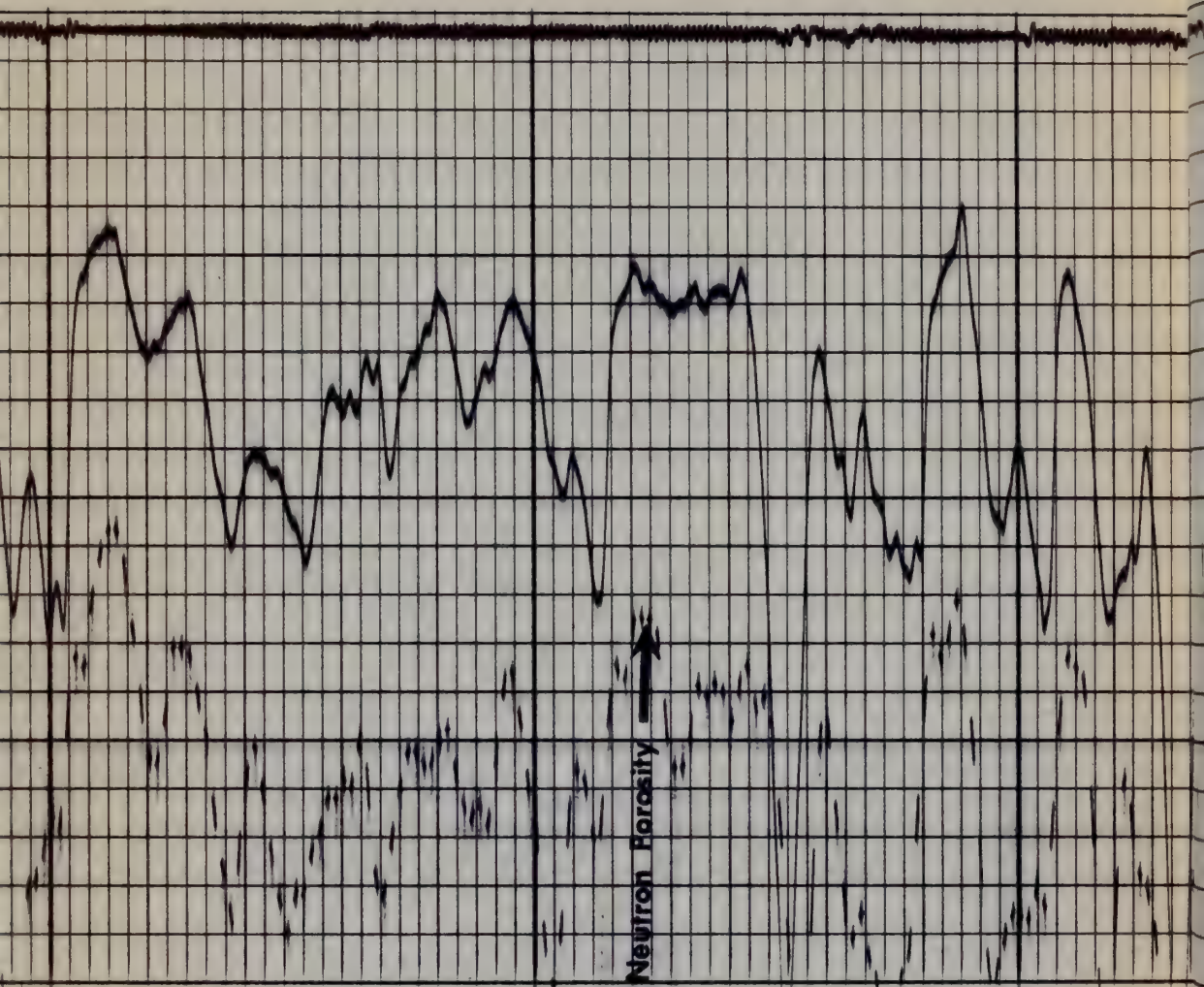
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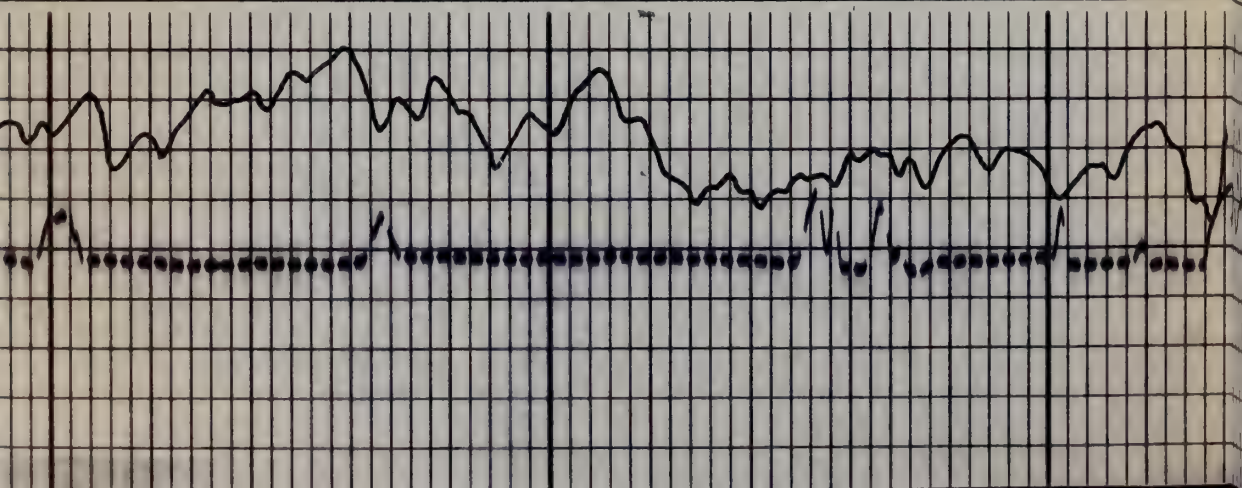
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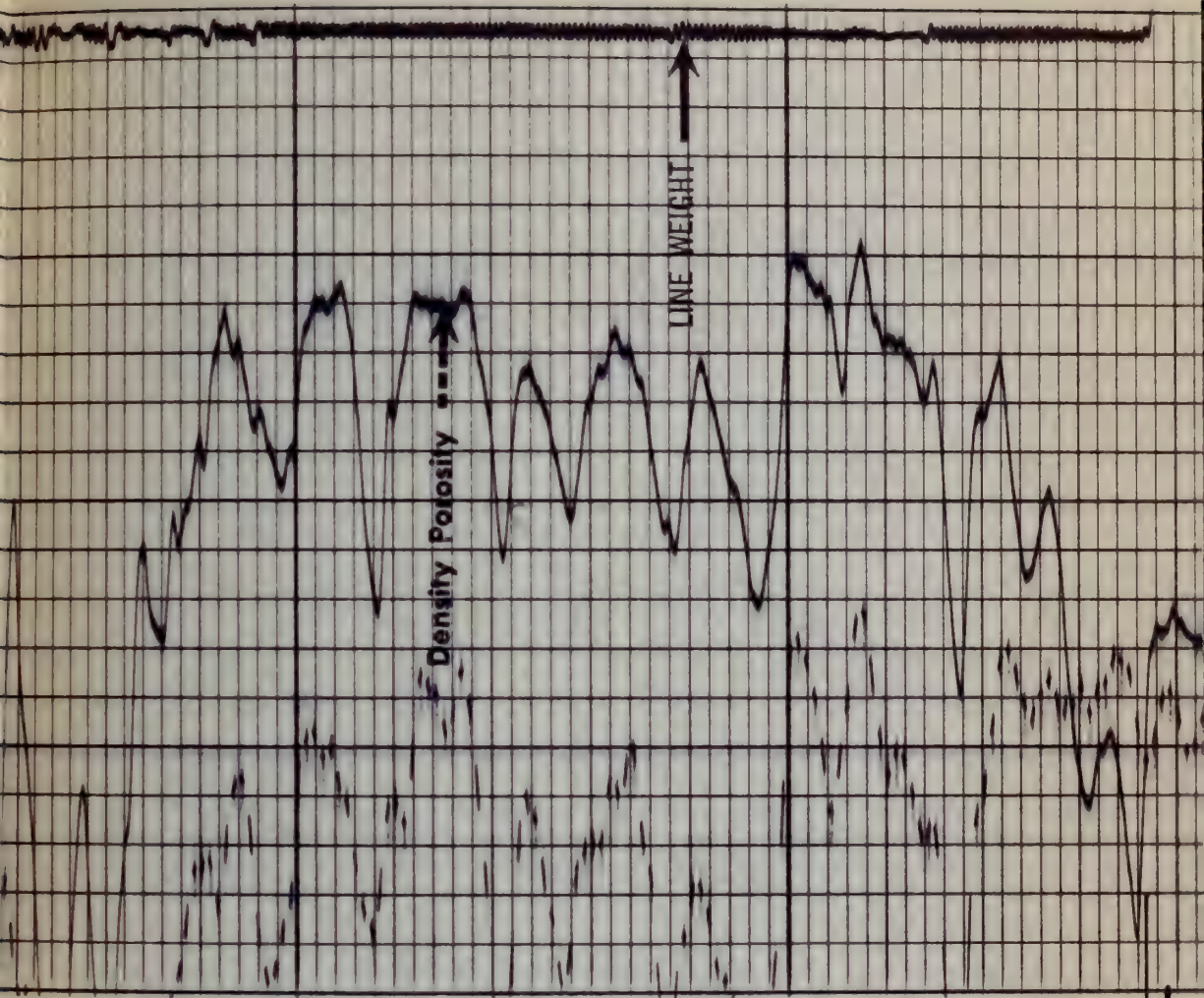




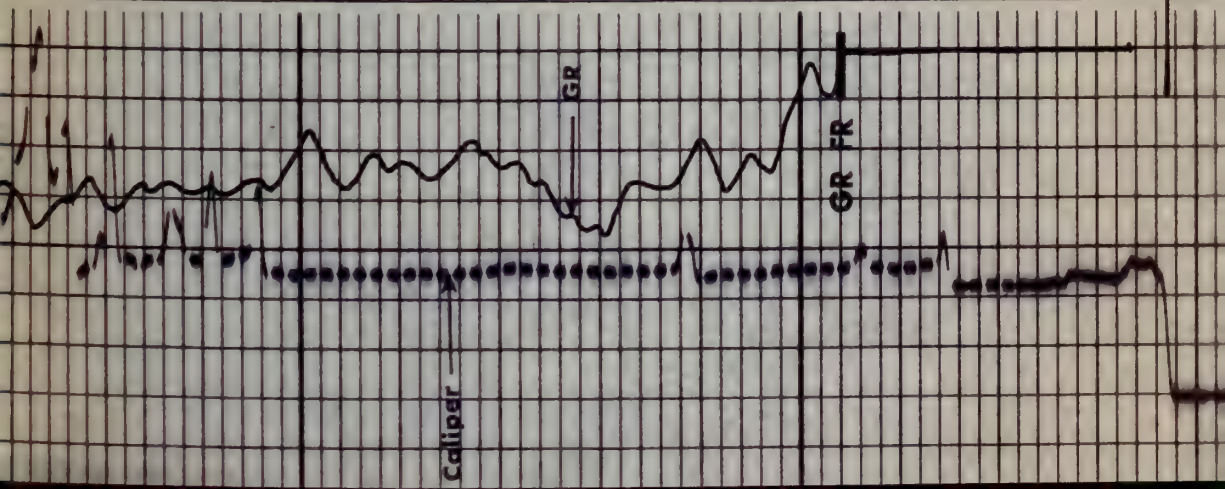
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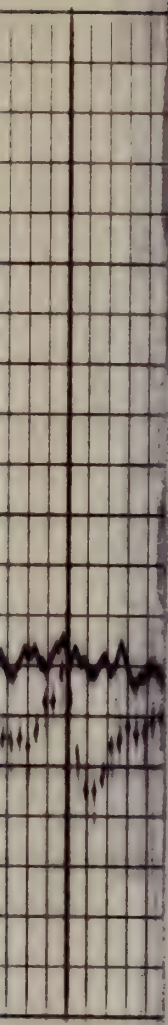
1200





1300





INCREMENTAL WEIGHT LINE
INCREASES APPROX.
500#/DIV.

60 45 30 15 0

NEUTRON POROSITY INDEX %
SANDSTONE MATRIX

60 45 30 15 0

DENSITY POROSITY INDEX %
SANDSTONE MATRIX

DEPTHS

0 150

150 300

GAMMA RAY
API UNITS

8 18

CALIPER
HOLE DIAM. IN INCHES

REPEAT SECTION

CALIPER

HOLE DIAM. IN INCHES

DEPTHS

DENSITY POROSITY INDEX %

SANDSTONE MATRIX

GAMMA RAY

API UNITS

NEUTRON POROSITY INDEX %

SANDSTONE

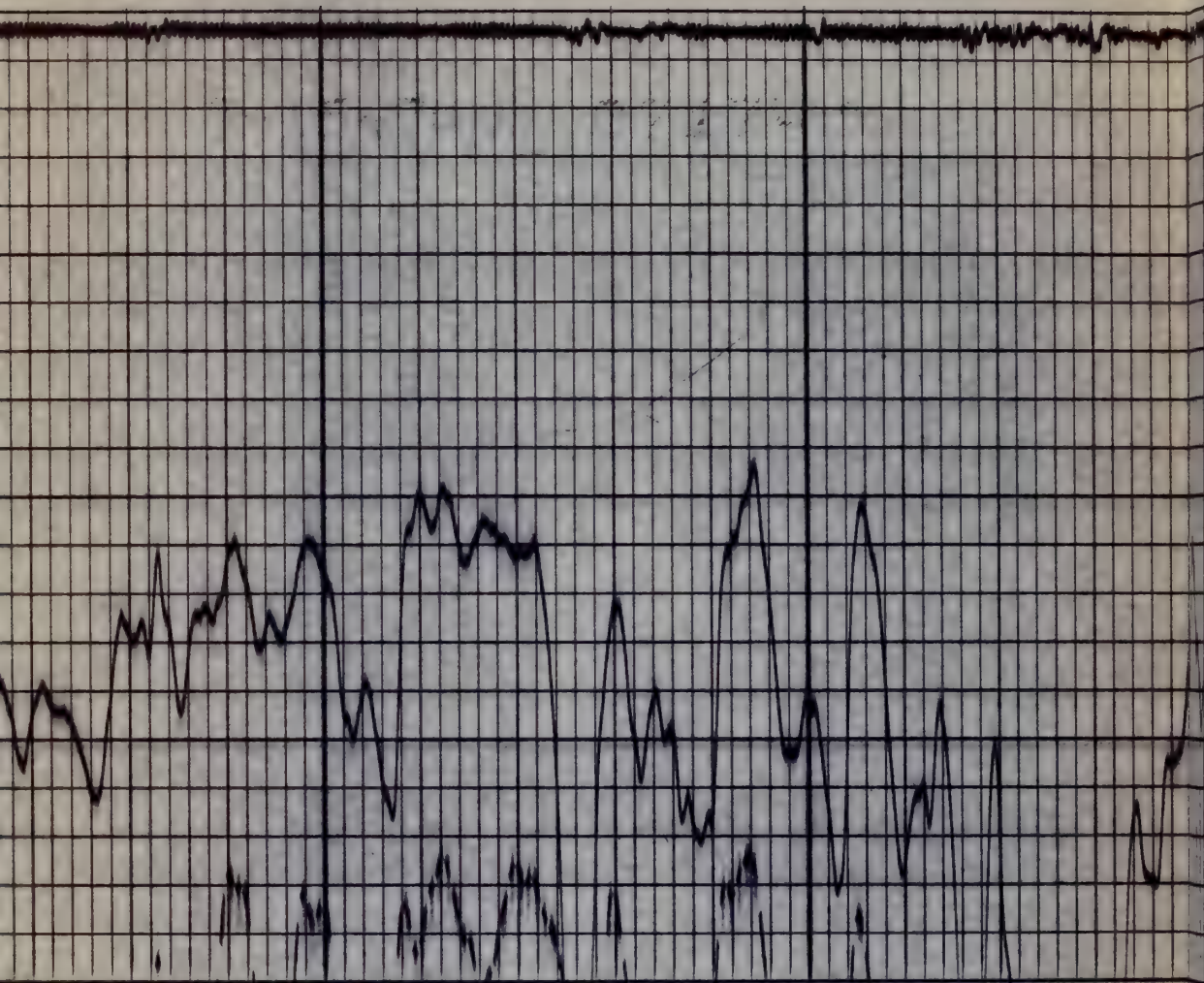
150

300

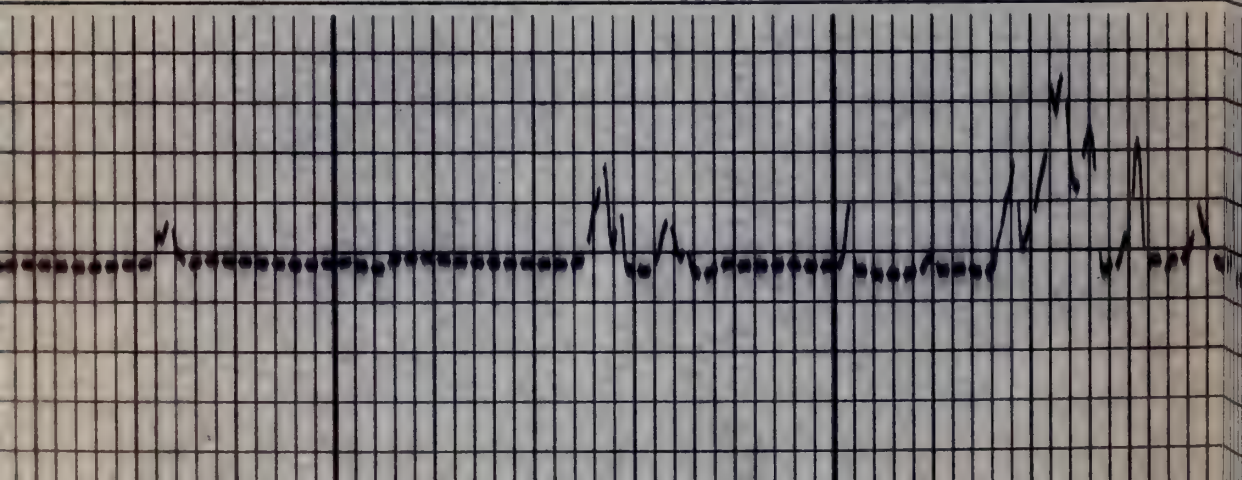
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INCREASES APPROX.
500#/DIV.

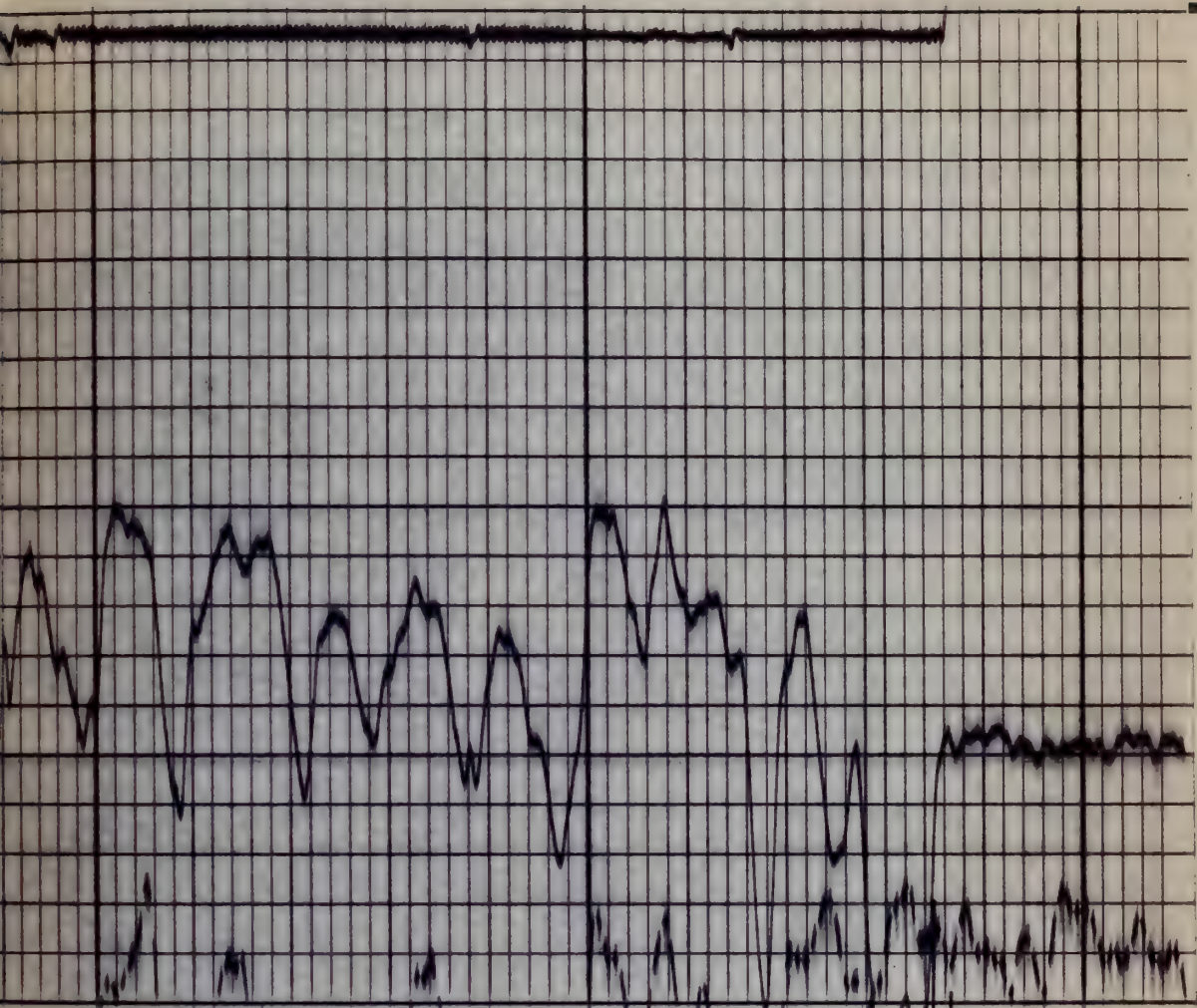
REPEAT SECTION

9100

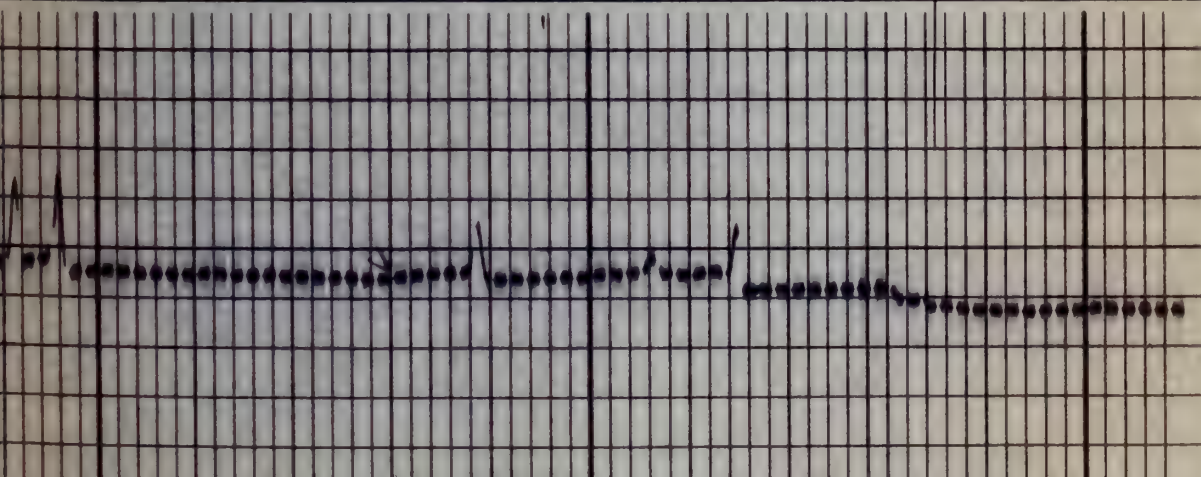


1200





130



INCREMENTAL WEIGHT
INCREASES APPROX.
500#/DIV.

LINE

0 150

150 300

GAMMA RAY
API UNITS

8 18

CALIPER

HOLE DIAM. IN INCHES

DEPTHS

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO

STATE COLORADO

CALIBRATION RECORD

SCHL. FR 1337

SCHL. TD 1339

DRLR TD 1338

Elev:

KB -----

DF -----

GI 6909

NEUTRON POROSITY INDEX %
SANDSTONE MATRIX

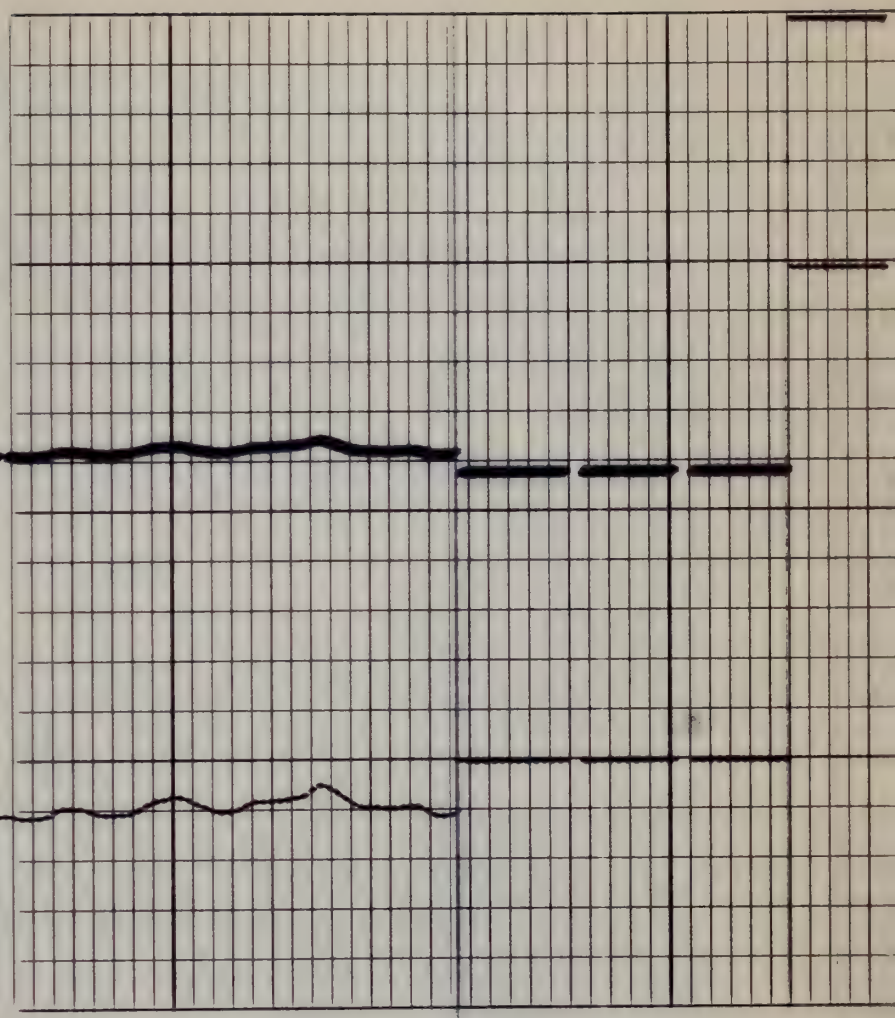
30 20 10 0 -10

DENSITY POROSITY INDEX %
SANDSTONE MATRIX

CALIBRATION RECORD



Calibration after Survey

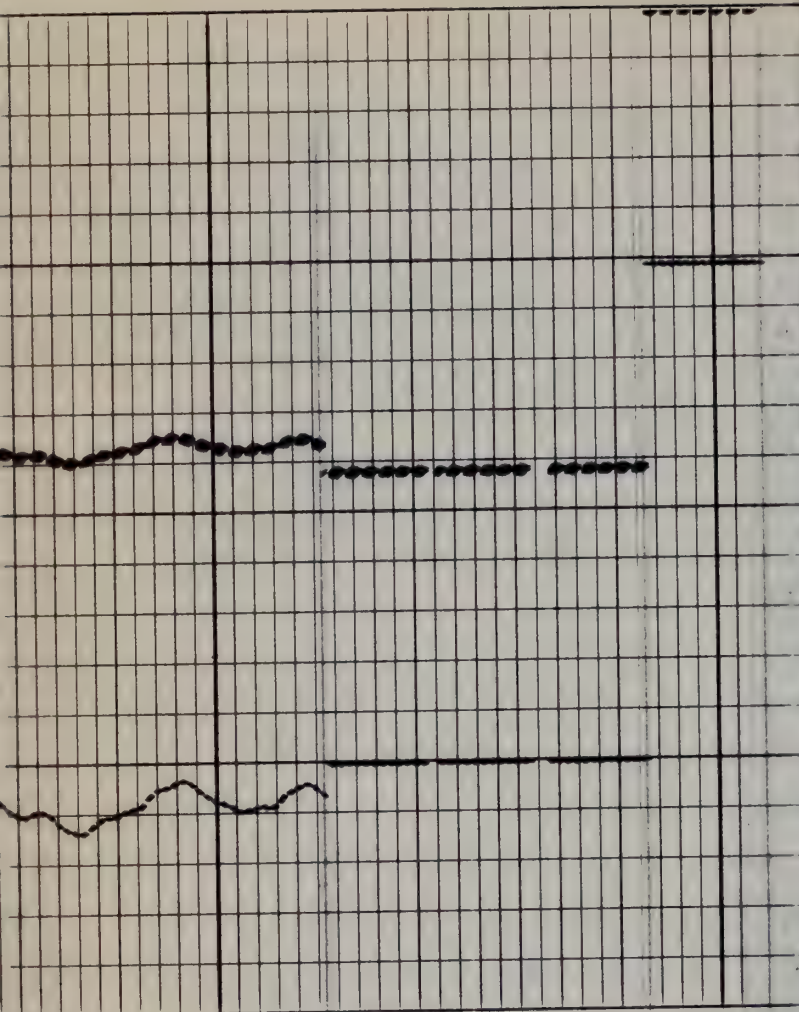


8

7

2

1

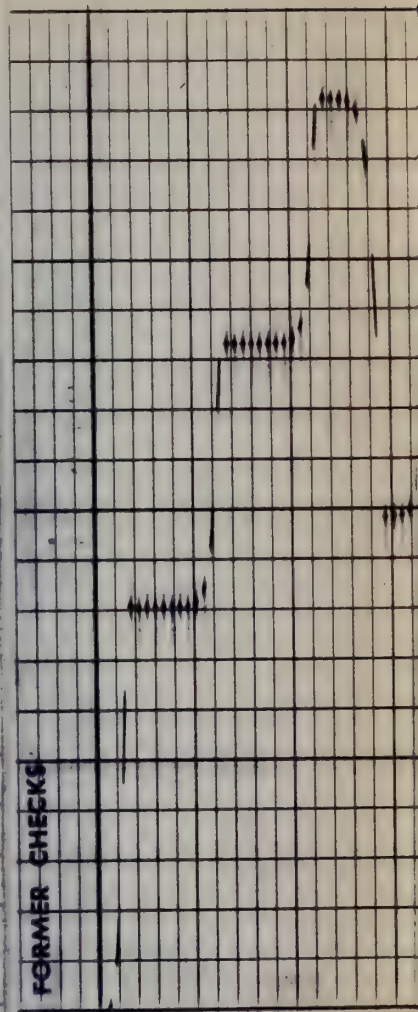
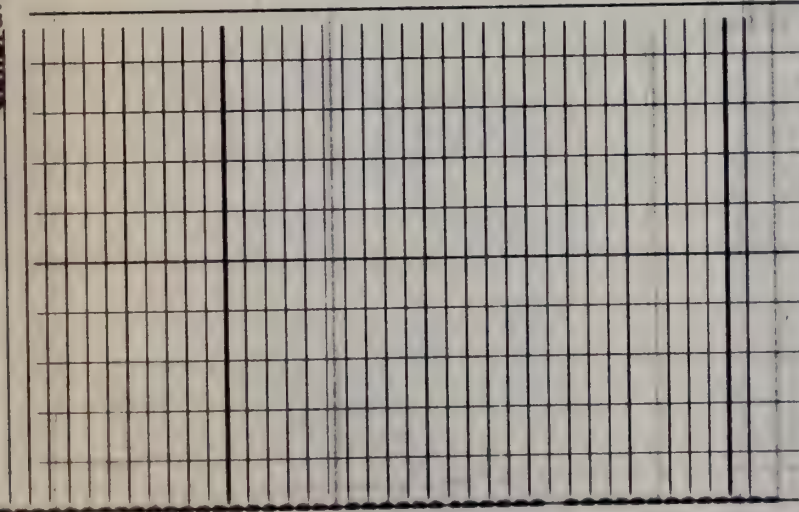


8

7

2

1



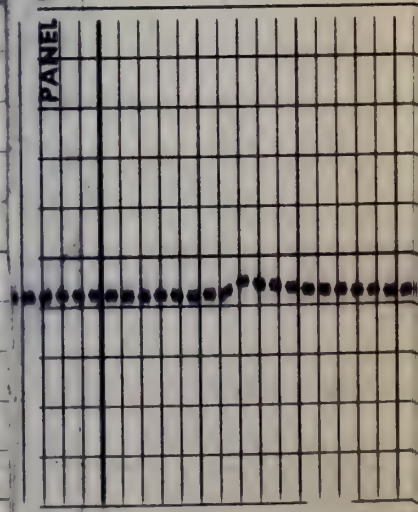
5

4

3

2

PANEL FUNCTION FORMER CHECKS



COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

PANEL TEST

RATIO	OH POROSITY			CH POROSITY	
	LS <input type="checkbox"/>	SS <input type="checkbox"/>	DOL <input type="checkbox"/>	SS <input type="checkbox"/>	LS <input type="checkbox"/>
3.	1.6	4.9	-0.2	2.4	0.1
4.	15.6	19.7	8.1	13.0	9.0
5.	31.3	36.0	25.2	29.1	24.1
6.	52.2	61.4	53.0	52.2	45.2

POROSITY NORMALIZED WITH CNB-A IN PLACE

7A. TOOL IN NCT-B

LOG POSITION WITH CNB-A IN PLACE

8A. LOG POSITION WITH TOOL IN NCT-B

RATIO	OH			CH	
	LS	SS	DOL	SS	LS
18	22.2	22.2	10.4	15.3	11.2

$$\text{RATIO (NORMALIZED)} = \frac{2.17}{\text{RATIO (NCT-B)}} \quad \text{RATIO LOG}$$

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

POS	$\frac{\rho}{\Delta \rho}$	$\Delta \rho$
3. # 1	2.92	.00
4. # 2	2.78	+.14
5. # 3	2.42	-.10
6. # 4	2.35	.00
7. # 5	2.08	.01

MECHANICAL ZERO CALIBR

- 8. 8" RING
- 9. 12" RING
- 10. TOOL CALIBRATE #1 SET $p = 2.50$
- 11. TOOL CALIBRATE #2 SET $\Delta p = .00$
- 12. LOG POSITION $p = 2.59, \Delta p = .015$
- 13.



CALIBRATION RECORD

COMPANY	ATLANTIC RICHFIELD COMPANY	SCHL.	FR	1337
WELL	SORGUM GULCH AQUIFER NO. 1	SCHL.	TD	1339
FIELD		DRLR	TD	1338
COUNTY	RIO BLANCO	Elev:	KB	----
	STATE COLORADO		DF	----
			GL	6909

Schlumberger

TEMPERATURE LOG

COMPANY ATLANTIC RICHFIELD COMPANYWELL SORGUM GULCH AQUIFER NO. 1

FIELD _____

COUNTY RIO BLANCO STATE COLORADO

LOCATION

Sec. 7 Twp. 3S Rge. 96W

Other Services:

DIL BHC-GR
FDC-GR
CNL-GRPermanent Datum: GL; Elev.: 6909
Log Measured From GL, 0 Ft. Above Perm. Datum
Drilling Measured From GLElev.: K.B. ----
D.F. ----
G.L. 6909

Date	<u>7-5-74</u>		
Run No.	<u>ONE</u>		
Depth—Driller	<u>1338</u>		
Depth—Logger	<u>1340</u>		
Btm. Log Interval	<u>1338</u>		
Top Log Interval	<u>350</u>		
Casing—Driller	<u>13-3/8</u>	@ <u>166</u>	@
Casing—Logger	<u>----</u>		
Casing Size	1	To	To
	2	To	To
Casing Weight	1		
	2		
Casing Thickness	1		
	2		
Bit Size	1	<u>12-1/4</u> To	To
	2	To	To
Type Fluid in Hole	<u>WATER</u>		
Dens.	Visc.		
Time Since Circ.			
BHT			
Equip.	Location	<u>7674</u>	<u>VERNAL</u>
Recorded By	<u>HAUGAARD</u>		
Witnessed By	<u>TATE</u>		

The well name, location and borehole reference data were furnished by the customer.

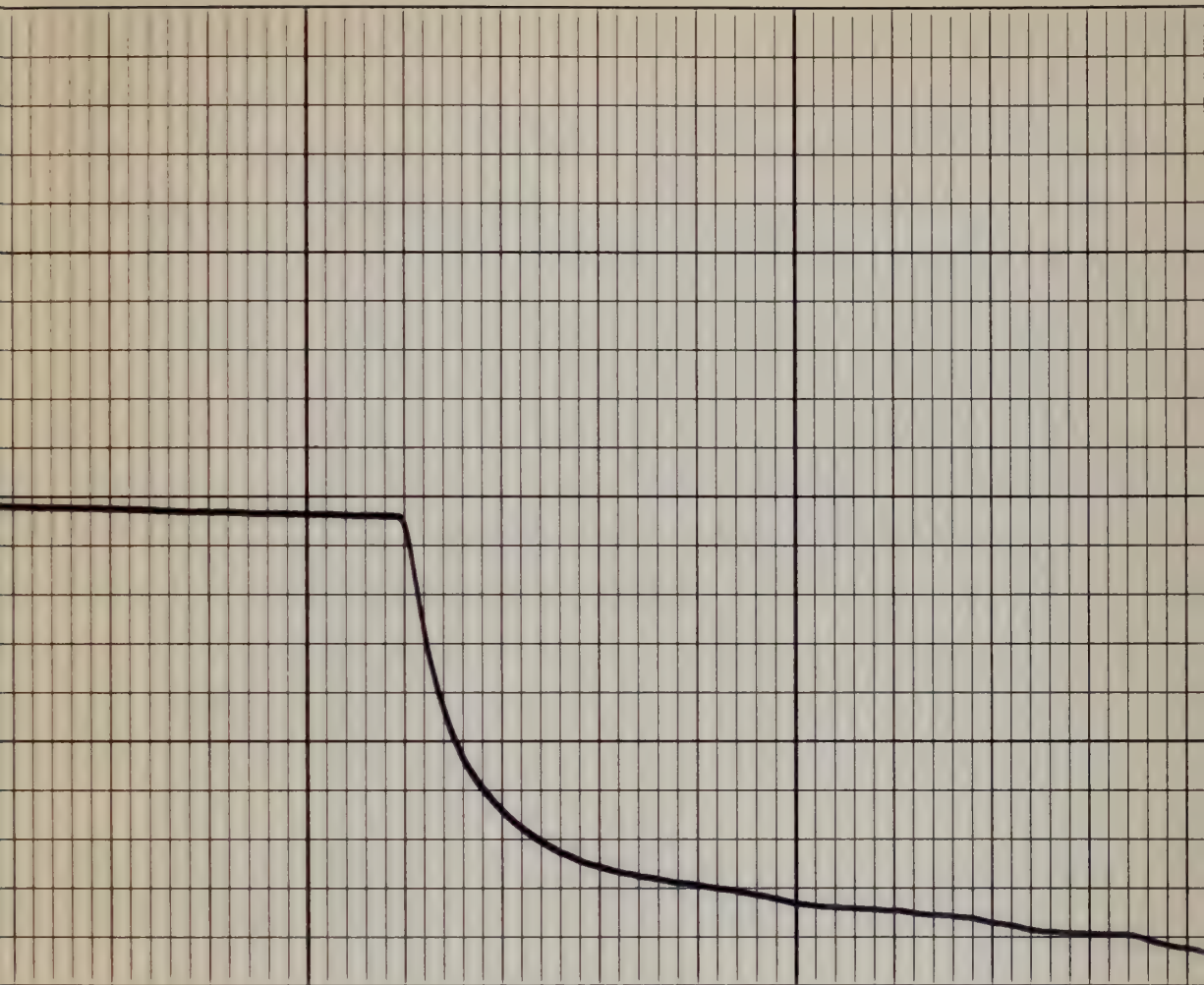
REMARKS: 50 #07174

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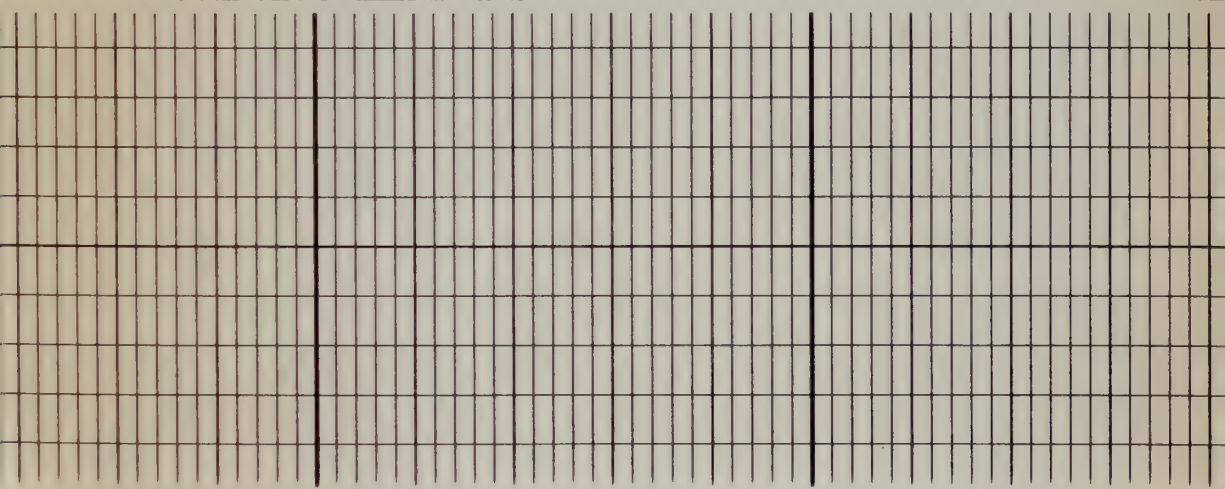
TEMPERATURE ° F.

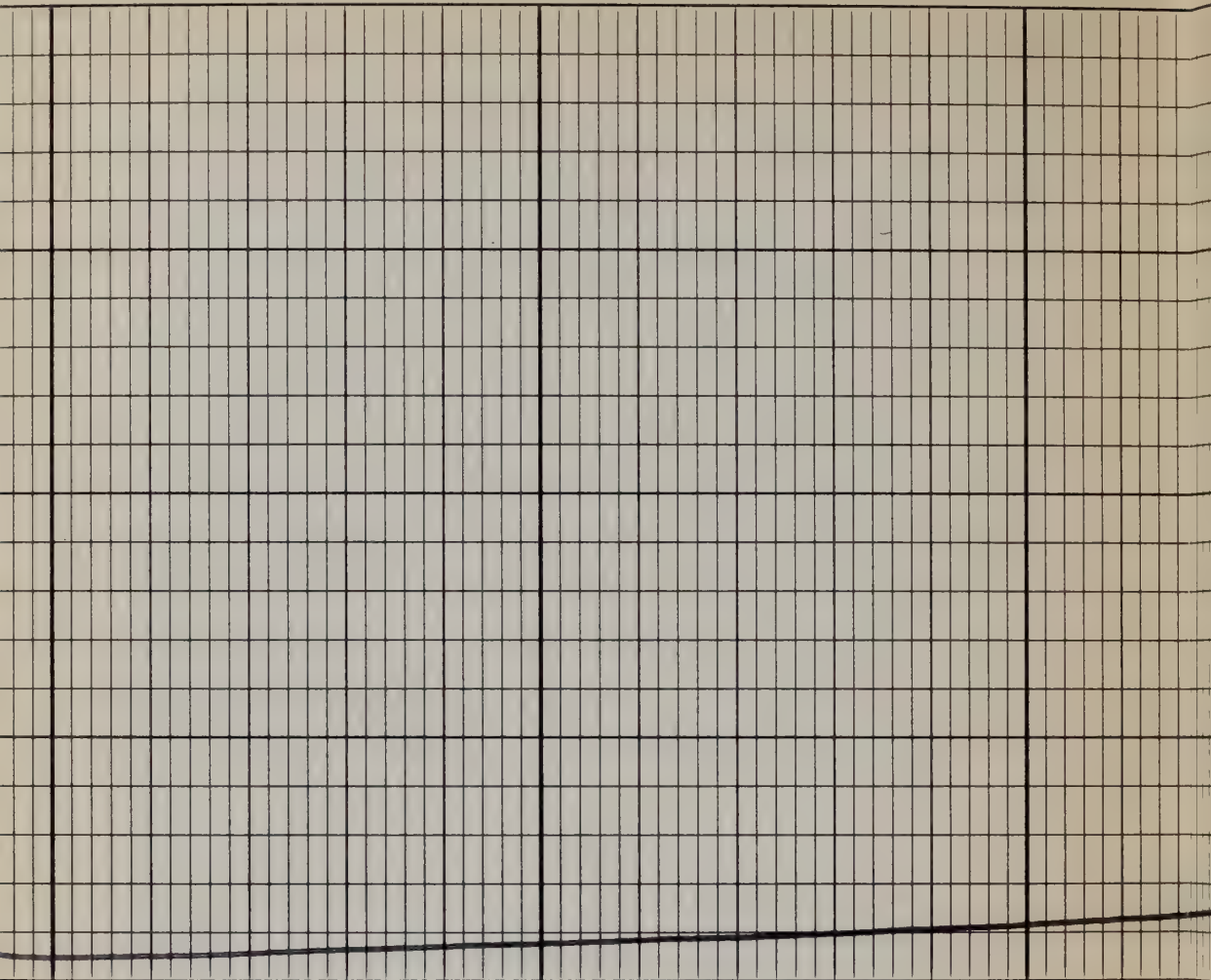
					60
					55
					50

[illegible]



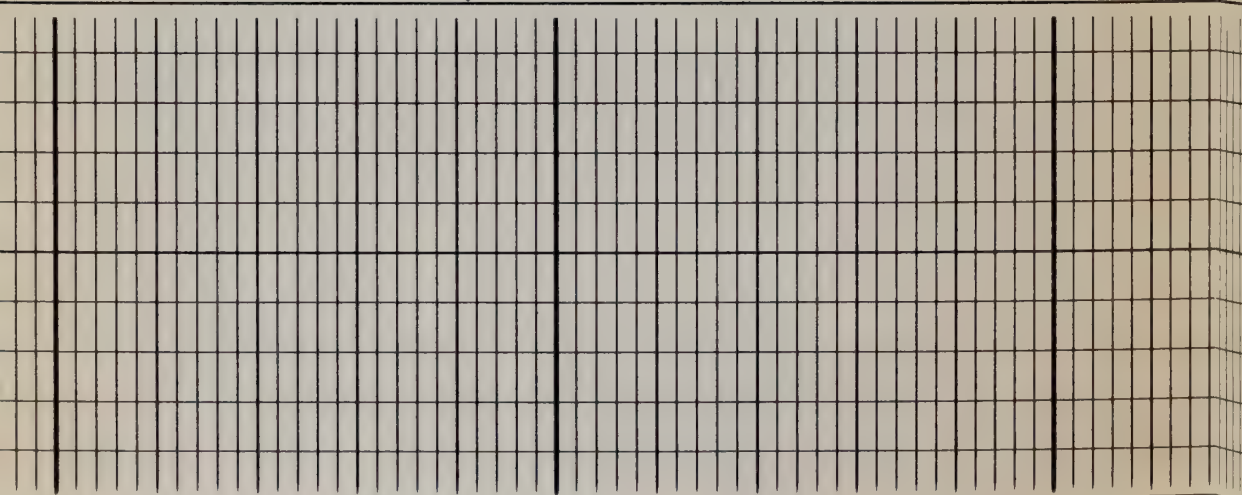
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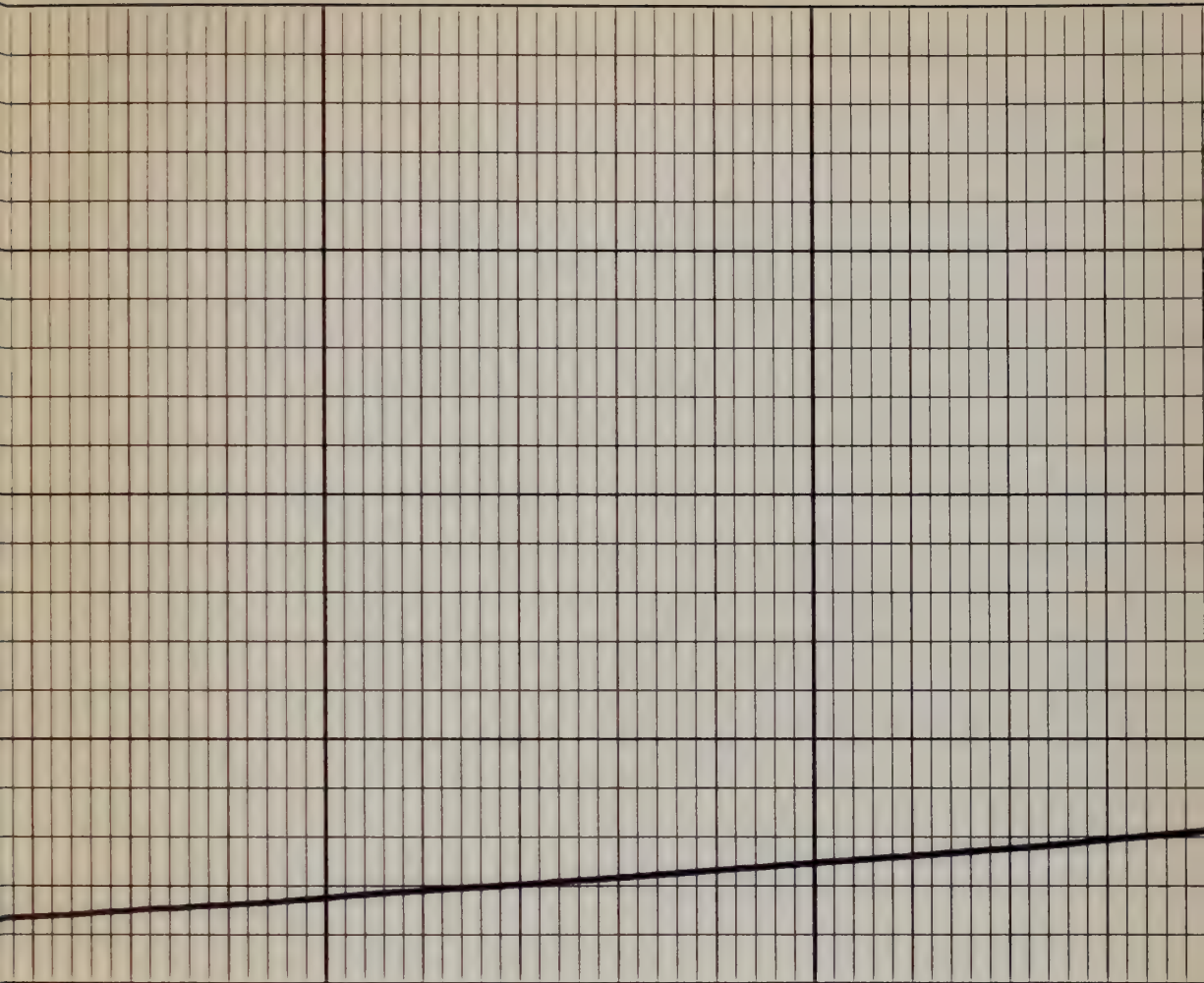




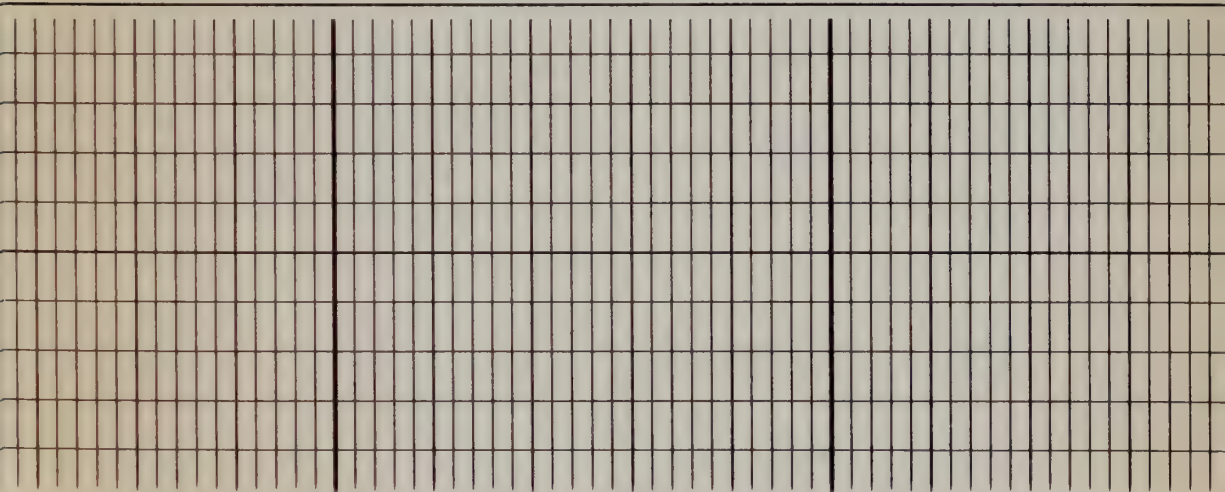
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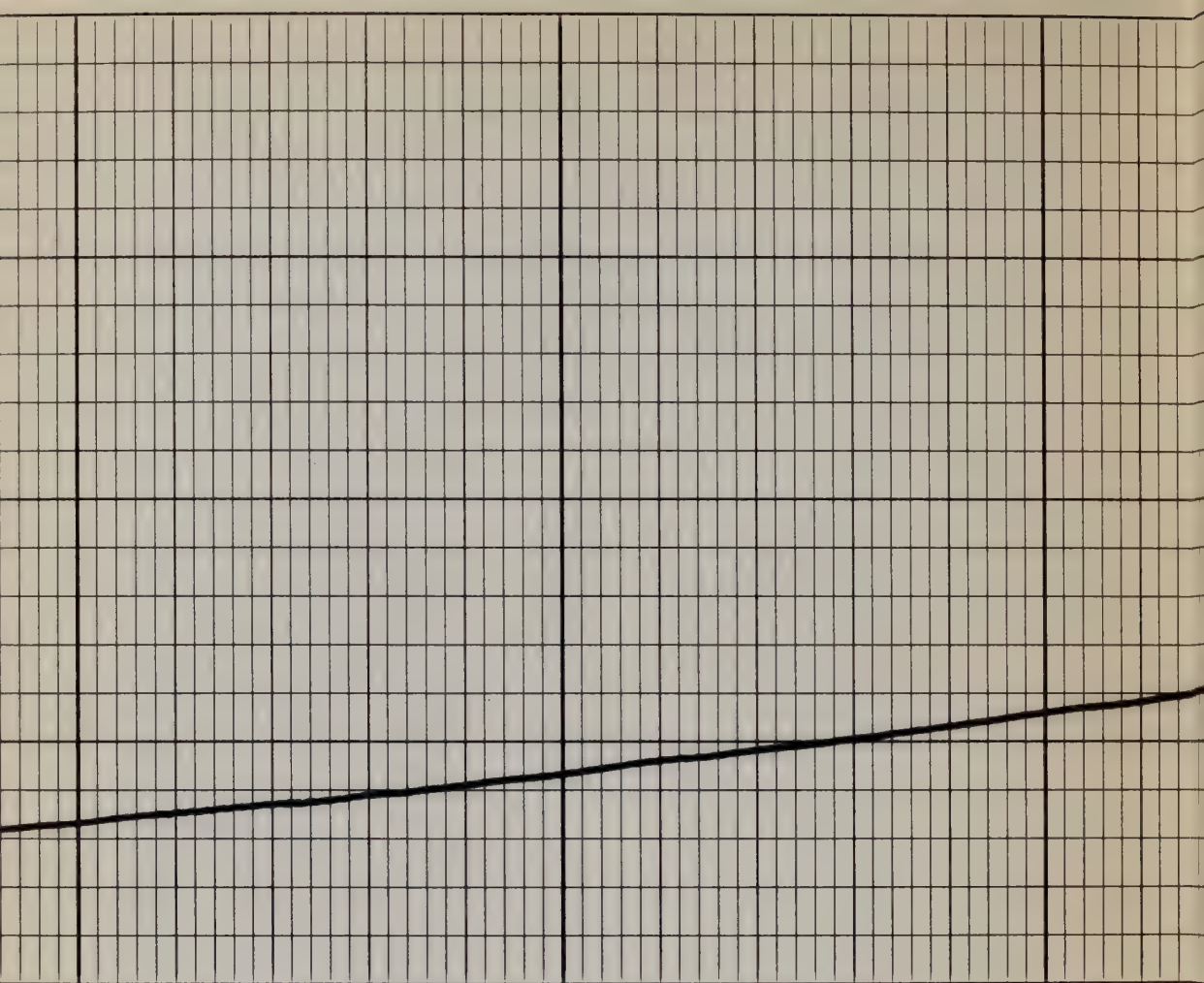
600



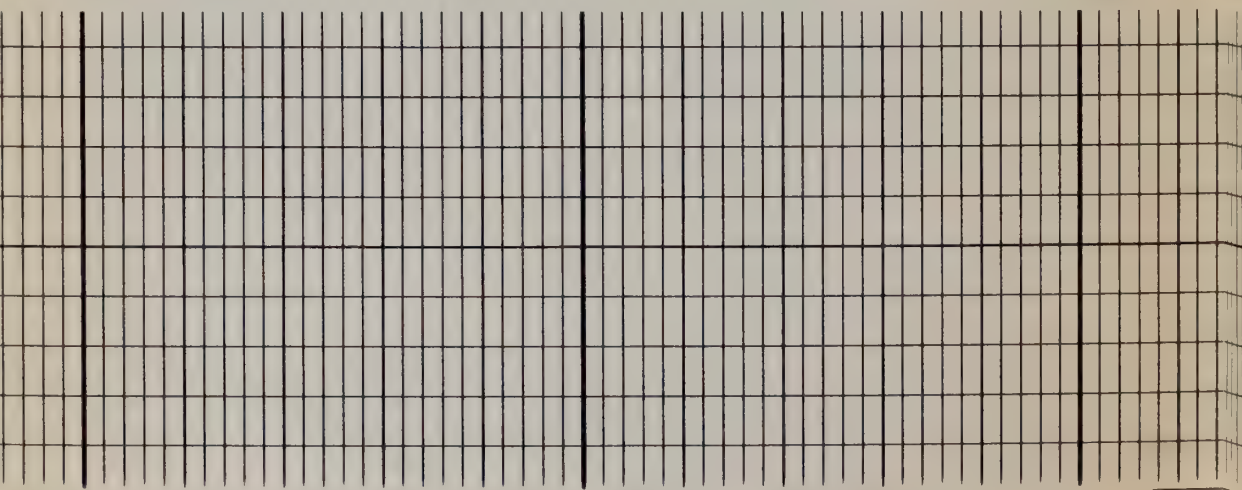


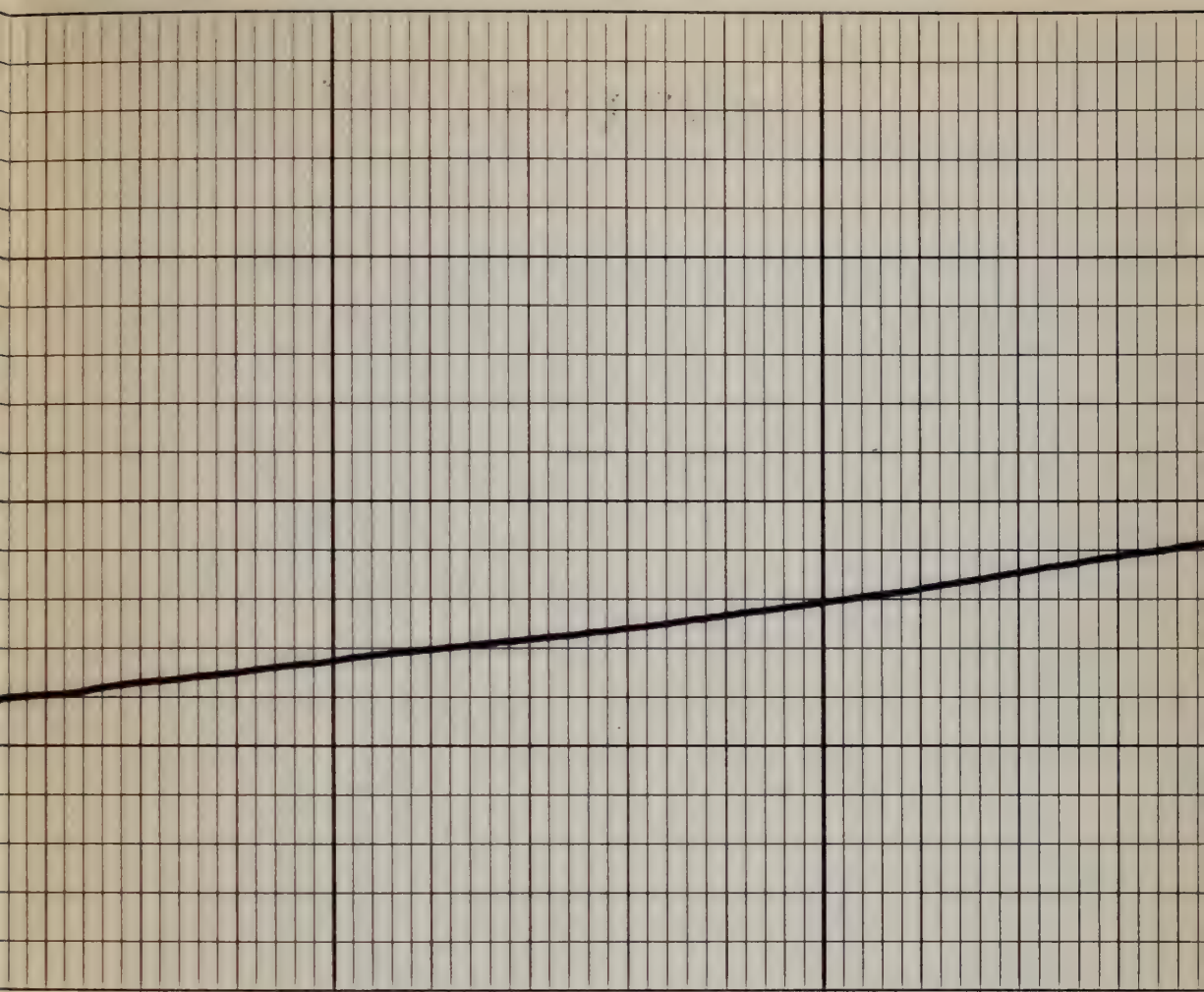
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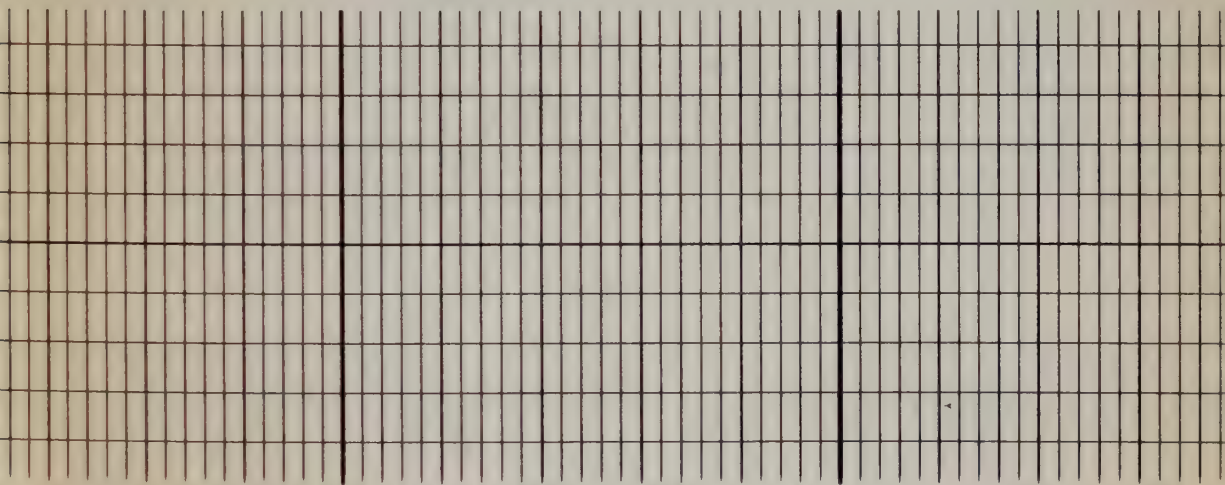


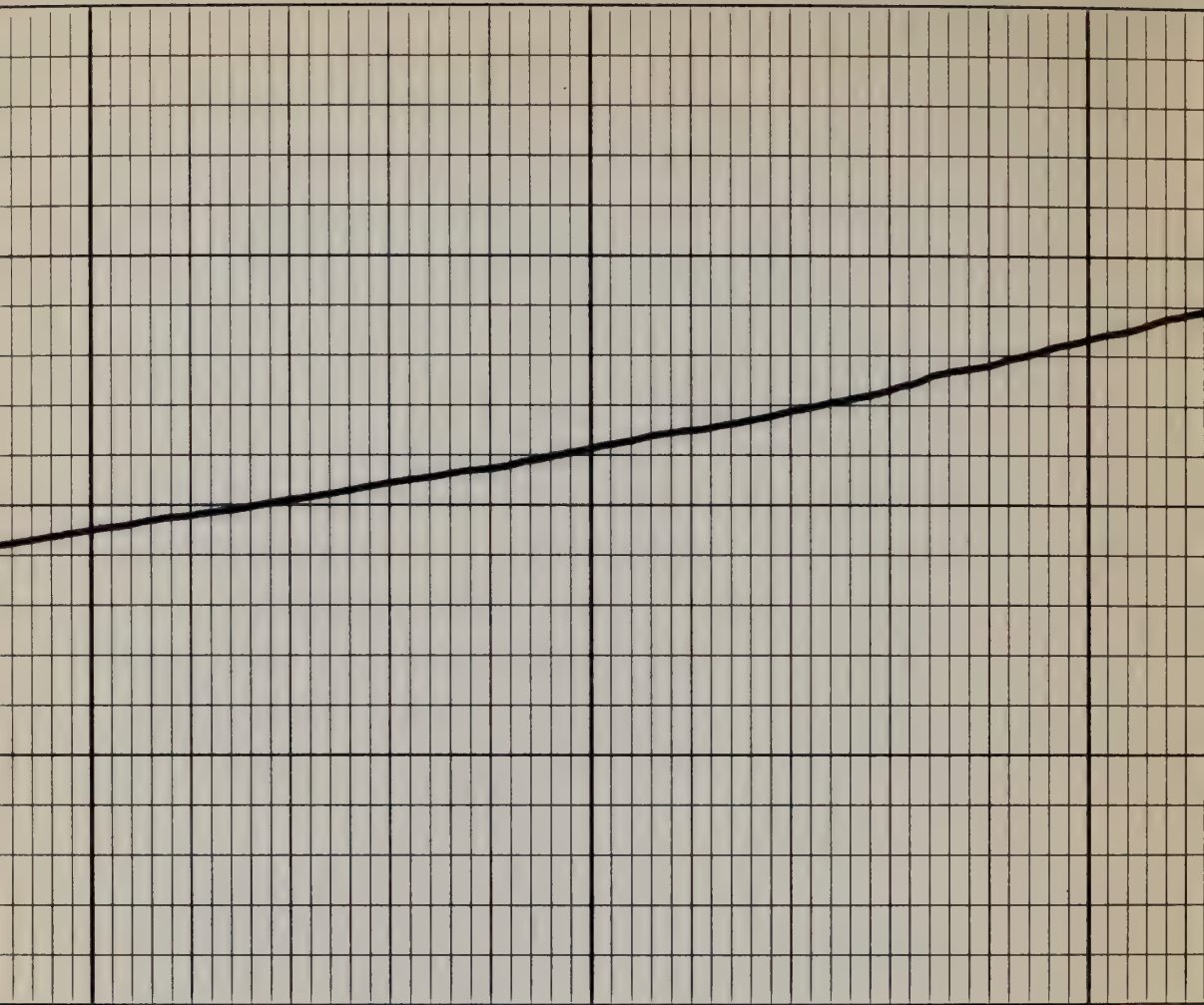
800





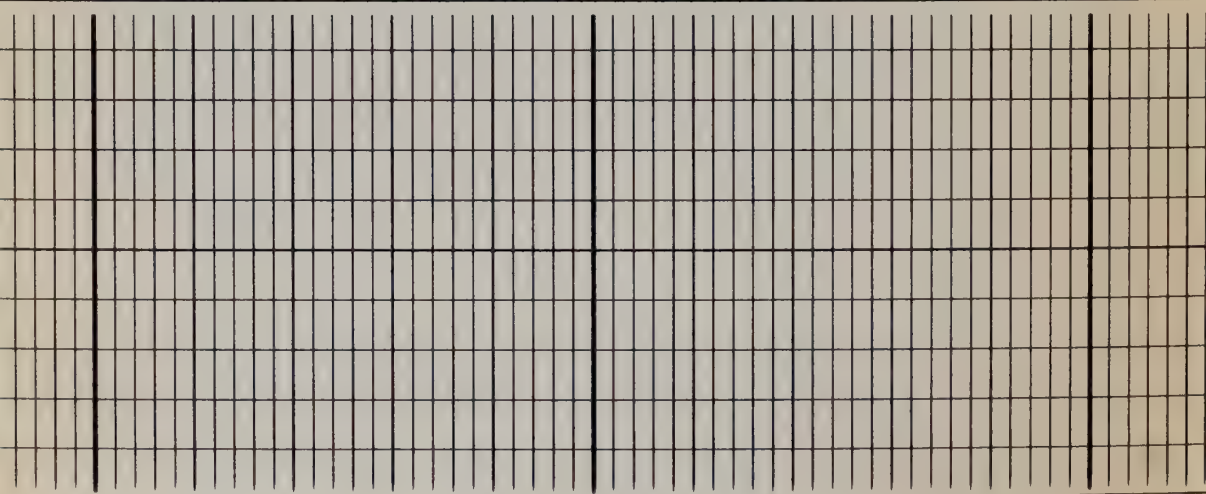
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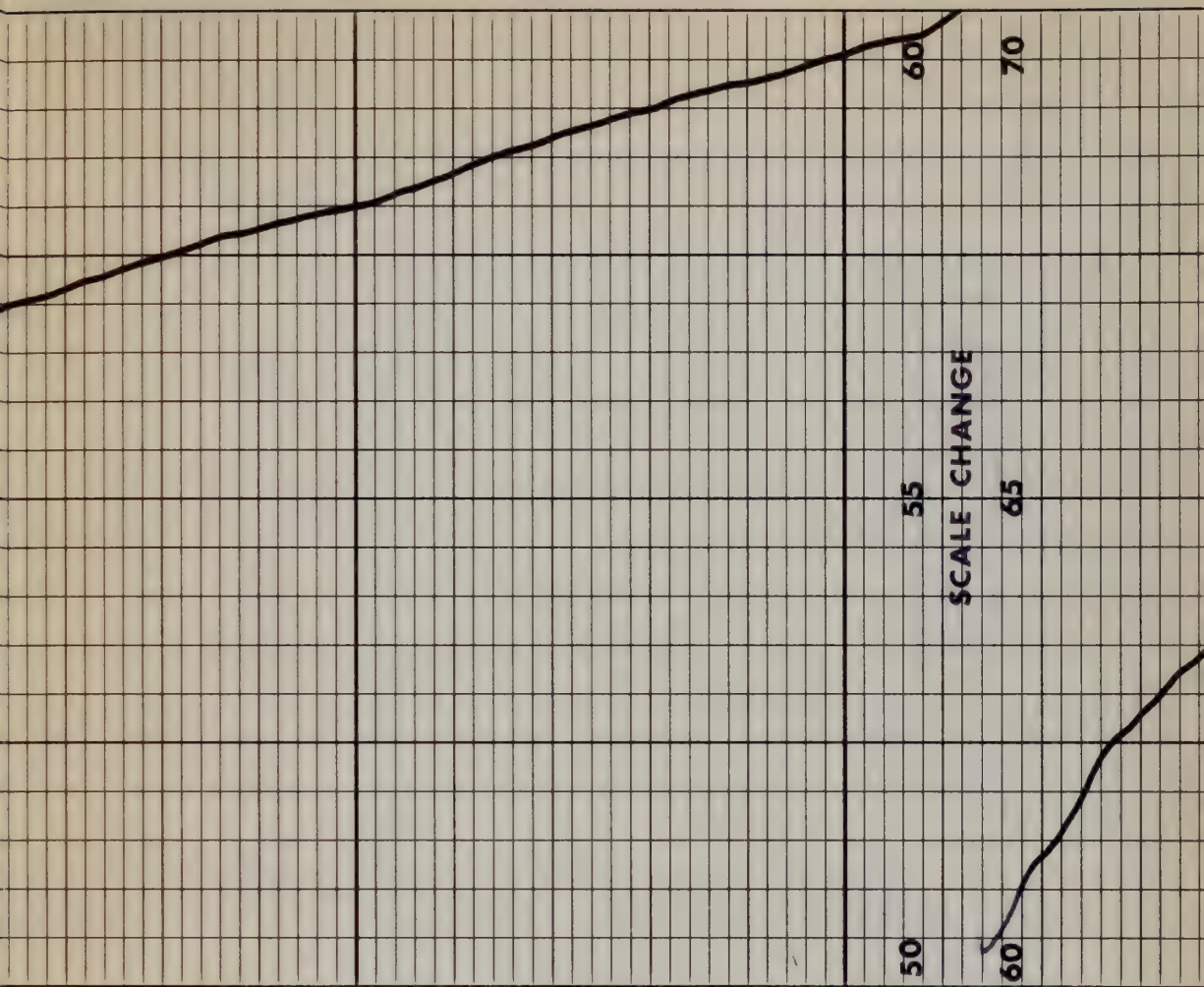




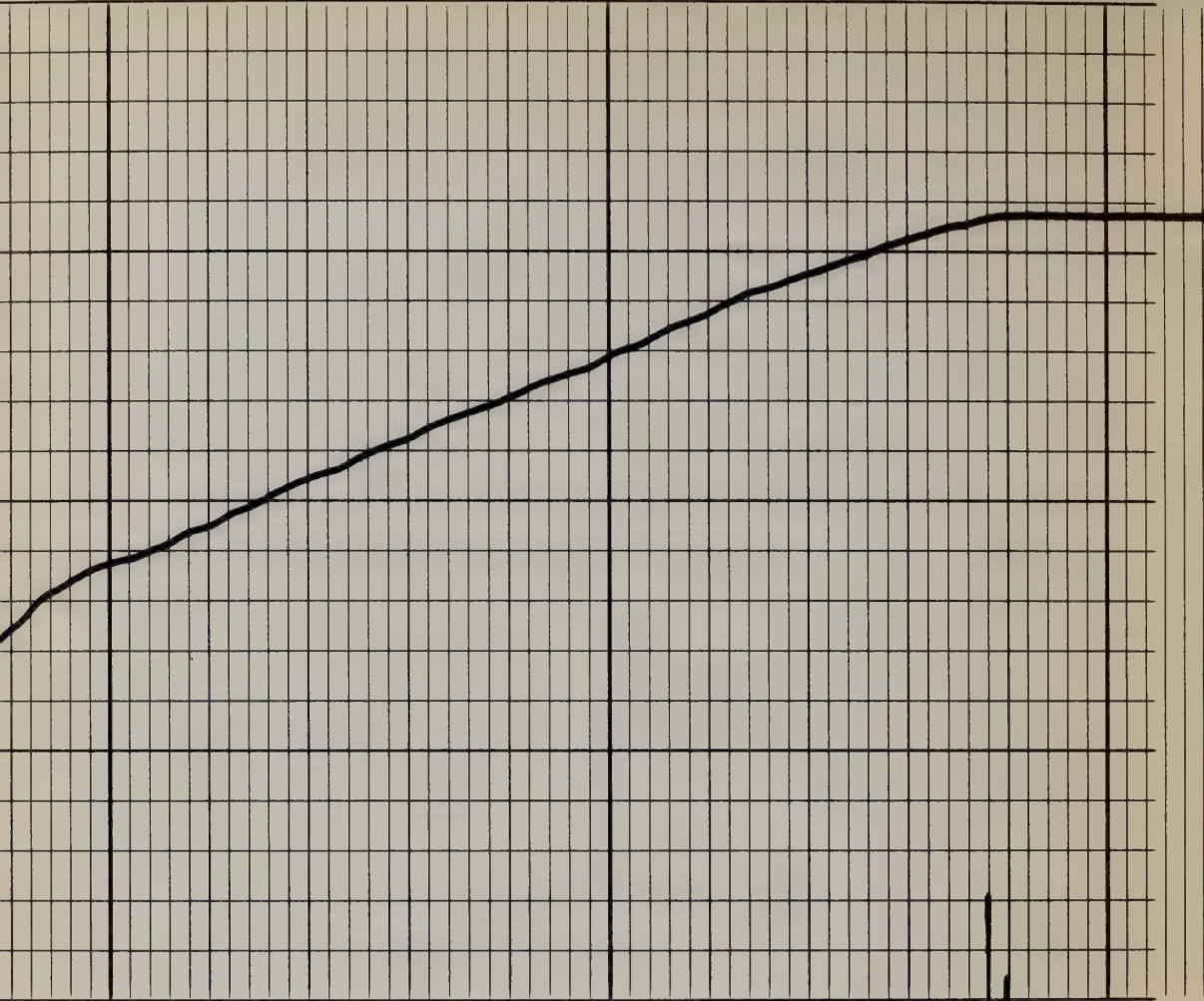
1000

1100

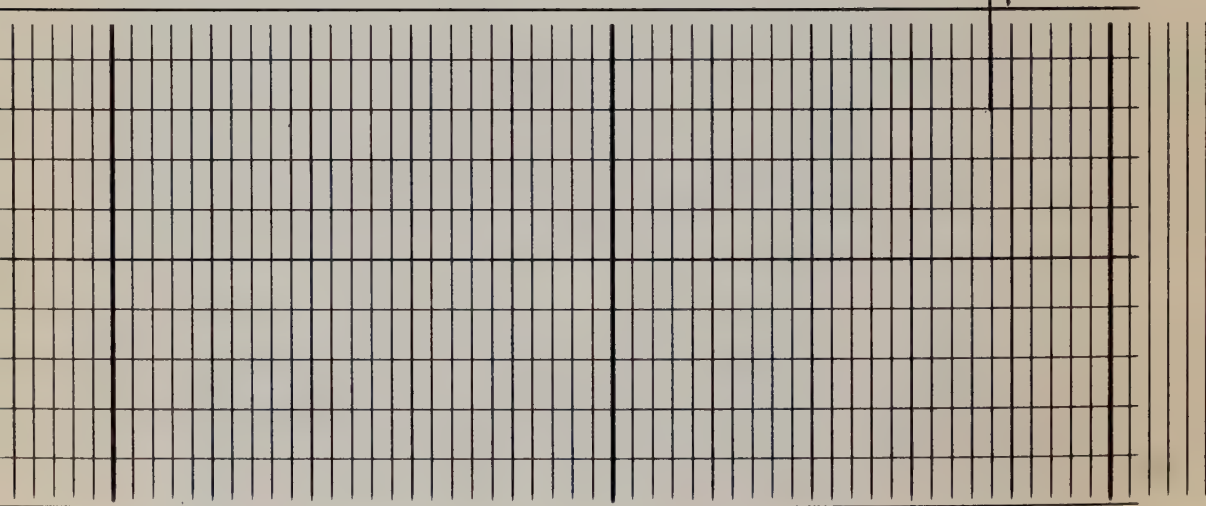




1200



1300



60

65

70

SCALE CHANGE

50

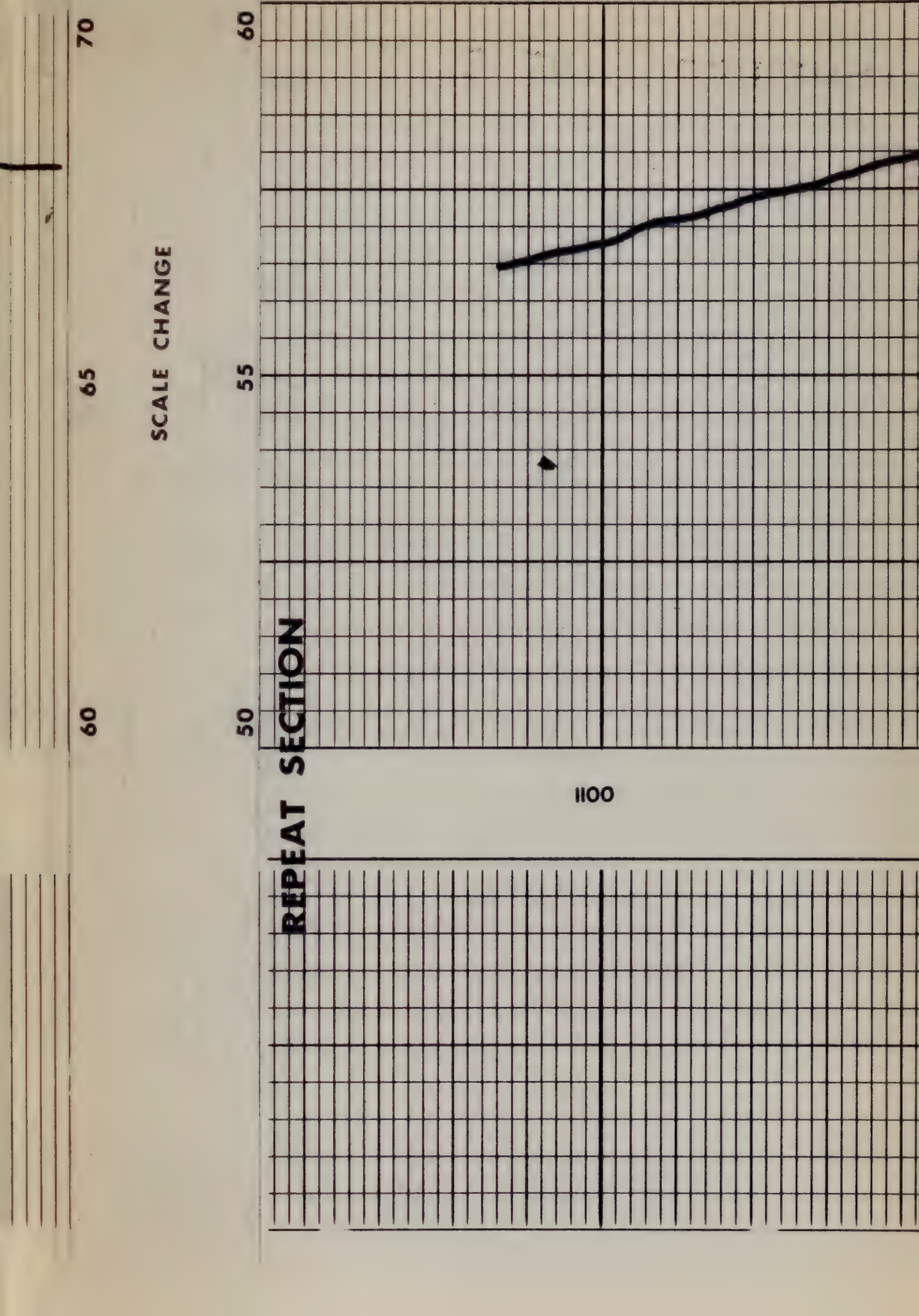
55

60

REPEAT SECTION

1100

1



TEMPERATURE ° F.

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1

FIELD

COUNTY RIO BLANCO

STATE COLORADO

SCHL. F. R. 1338

SCHL. T. D. 1340

DRLR. T. D. 1338

Schlumberger

TEMPERATURE LOG

RIO BLANCO

COUNTY

FIELD or

LOCATION

SORGUM GULCH

AQUIFER #1-A

ATLANTIC RICH.

COMPANY

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1-A

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION

Other Services:

Sec. 7 Twp. 3S Rge. 96W

Permanent Datum: GL ; Elev.: 6909
 Log Measured From GL 0 Ft. Above Perm. Datum
 Drilling Measured From GL

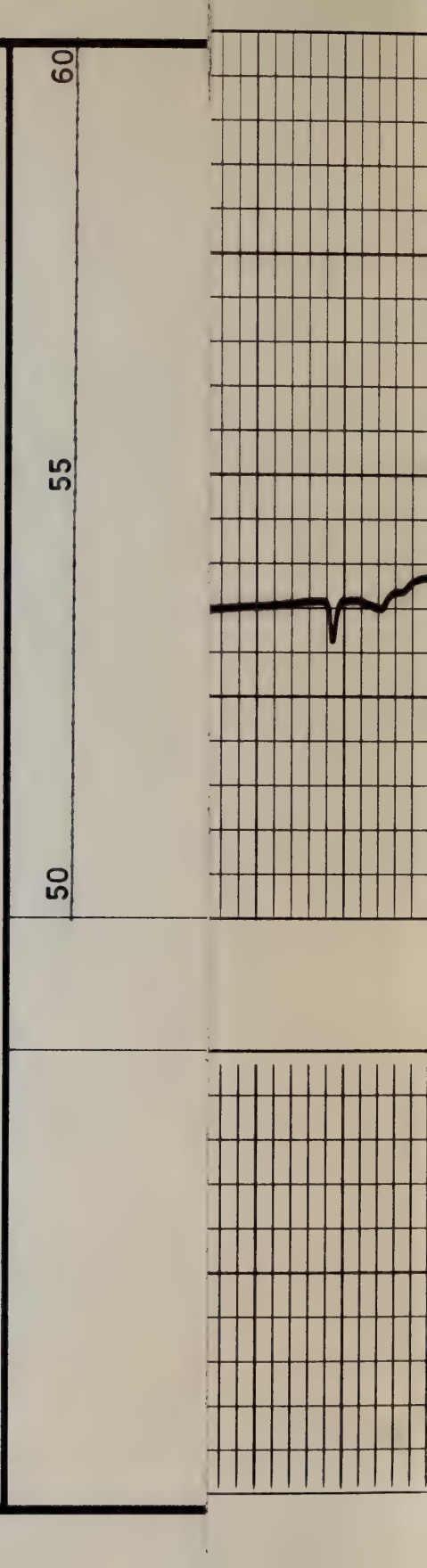
Elev.: K.B. ----
 D.F. ----
 G.L. 6909

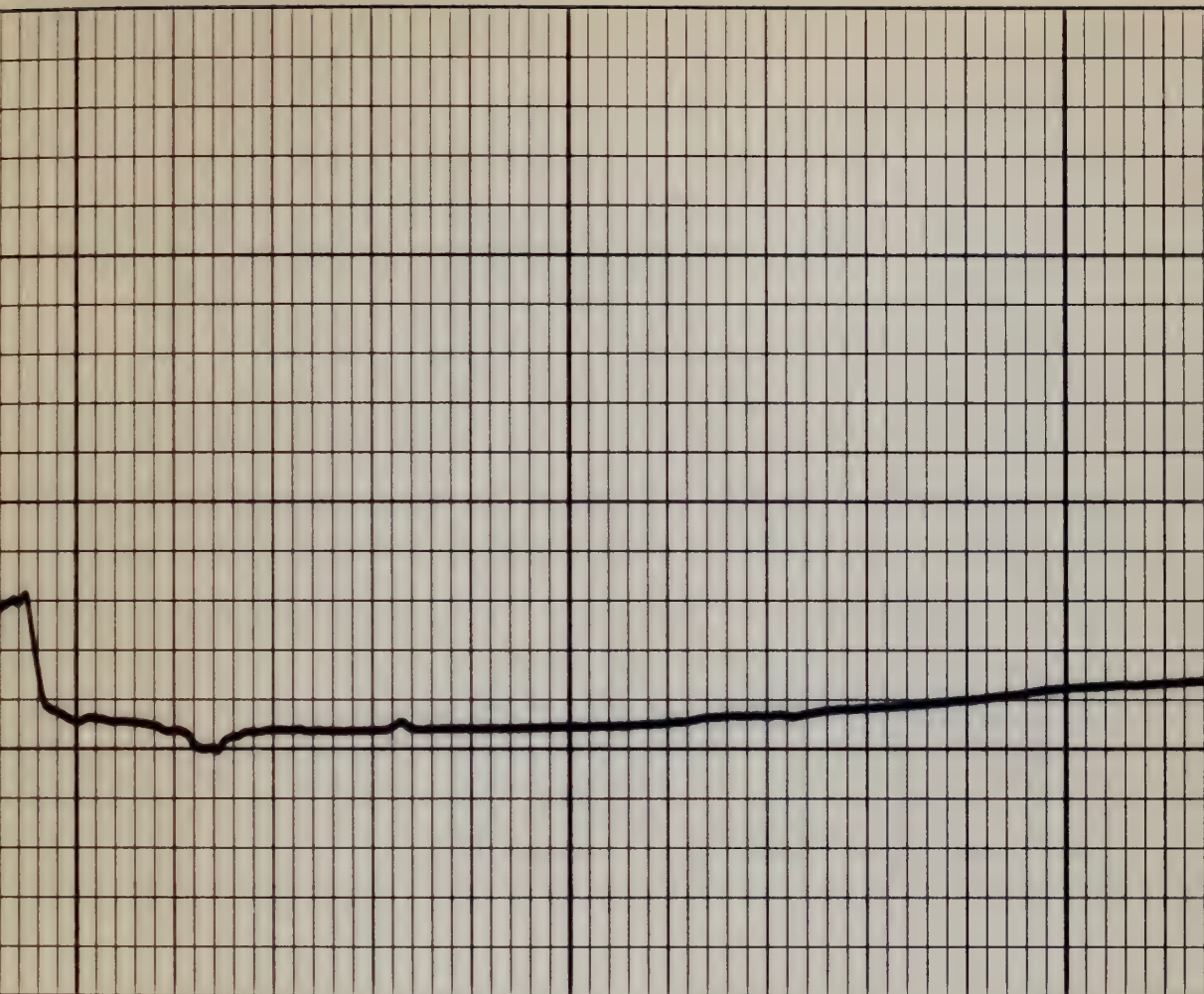
Date	7-6-74		
Run No.	ONE		
Depth-Driller	1620		
Depth-Logger	1620		
Btm. Log Interval	1618		
Top Log Interval	370		
Casing-Driller	7 @ 62	@	@
Casing-Logger	----		
Casing Size	1 To	To	To
	2 To	To	To
Casing Weight	1		
	2		
Casing Thickness	1		
	2		
Bit Size	1 6-1/4 To	To	To
	2 To	To	To
Type Fluid in Hole	WATER		
Dens.	Visc.		
Time Since Circ.			
BHT			
Equip.	Location	7674 VERNAL	
Recorded By	HAUGAARD		
Witnessed By	TATE		

REMARKS: S0 #07175

[illegible]

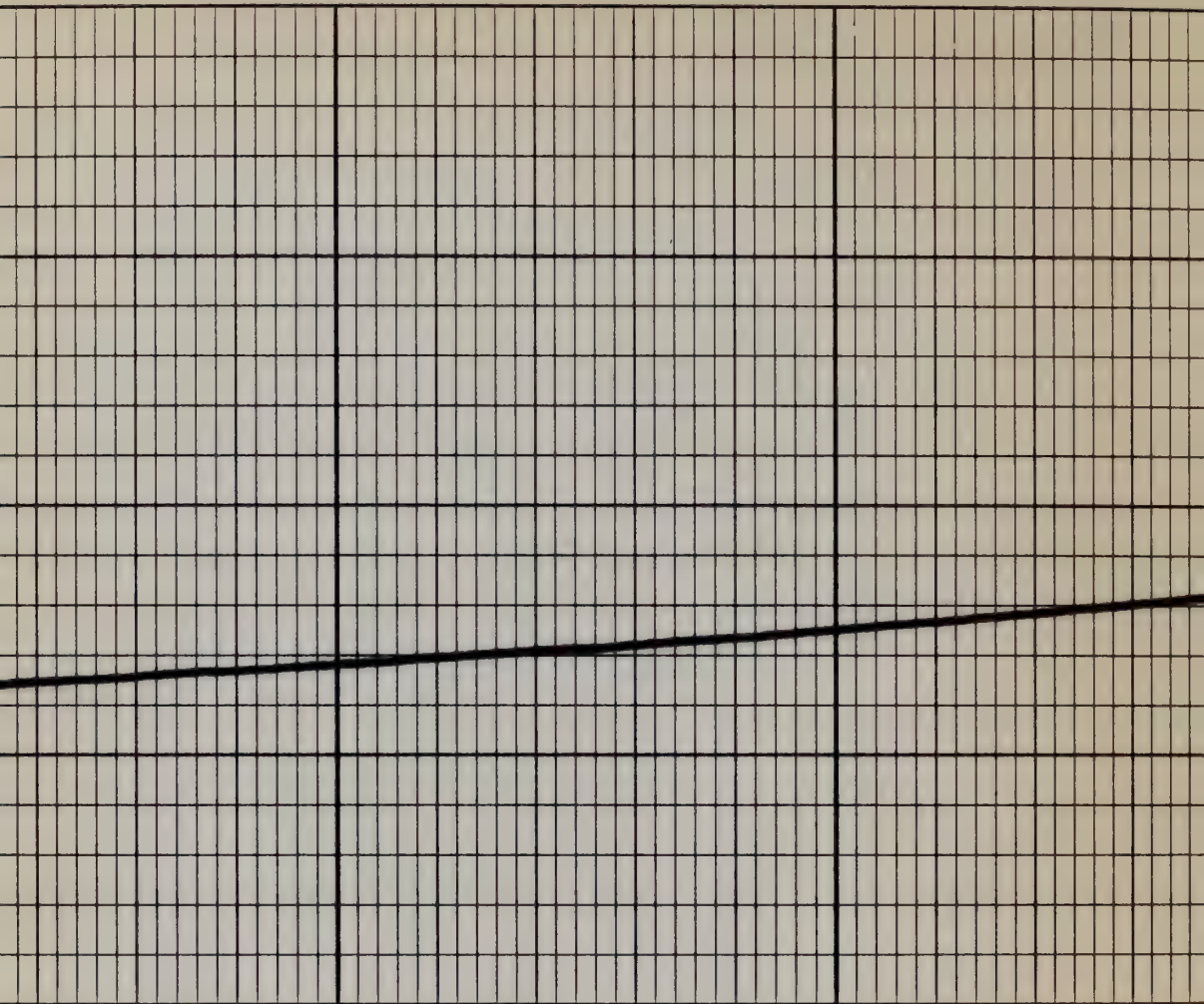
TEMPERATURE ° F.



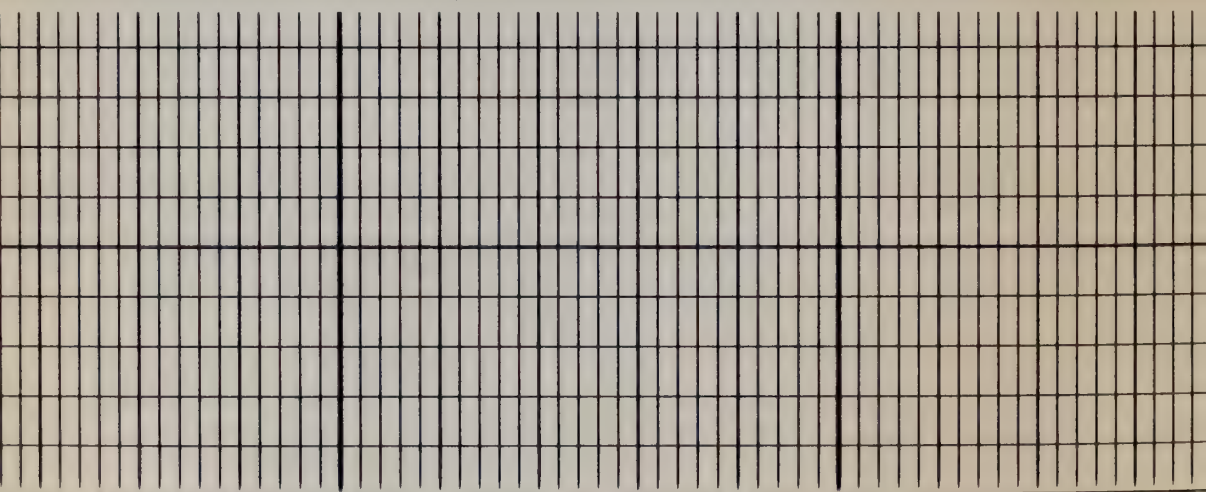


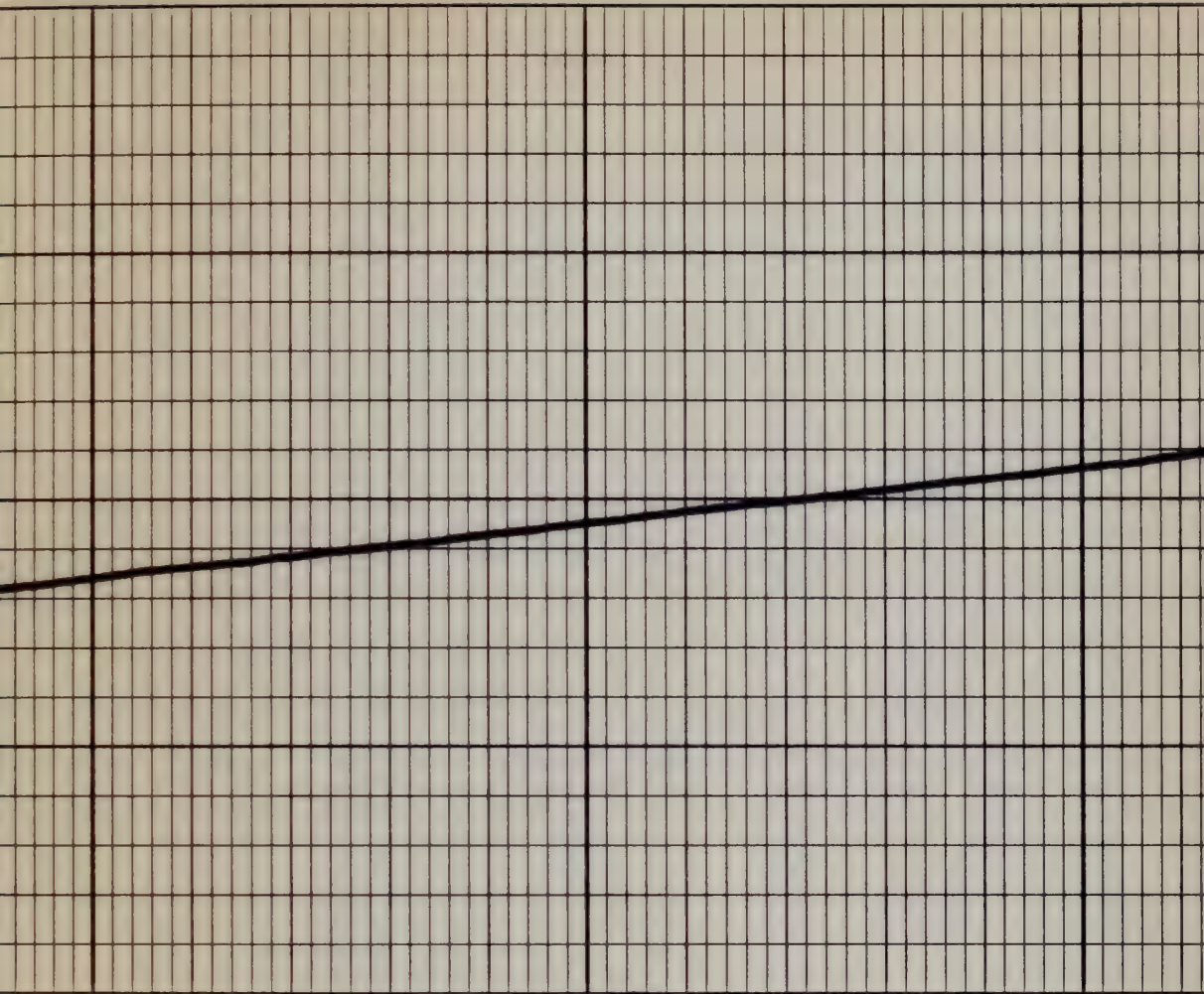
400

500

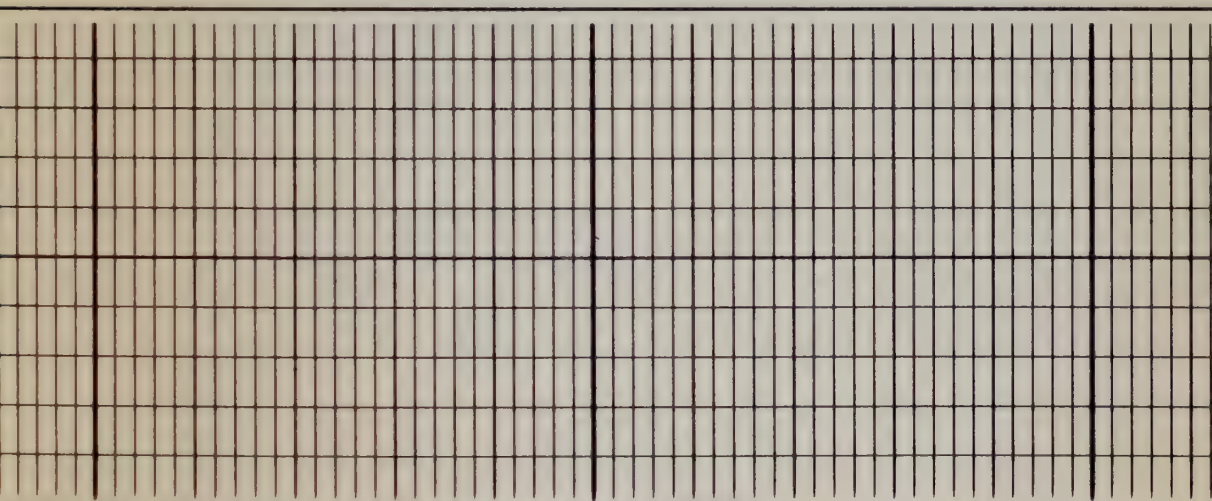


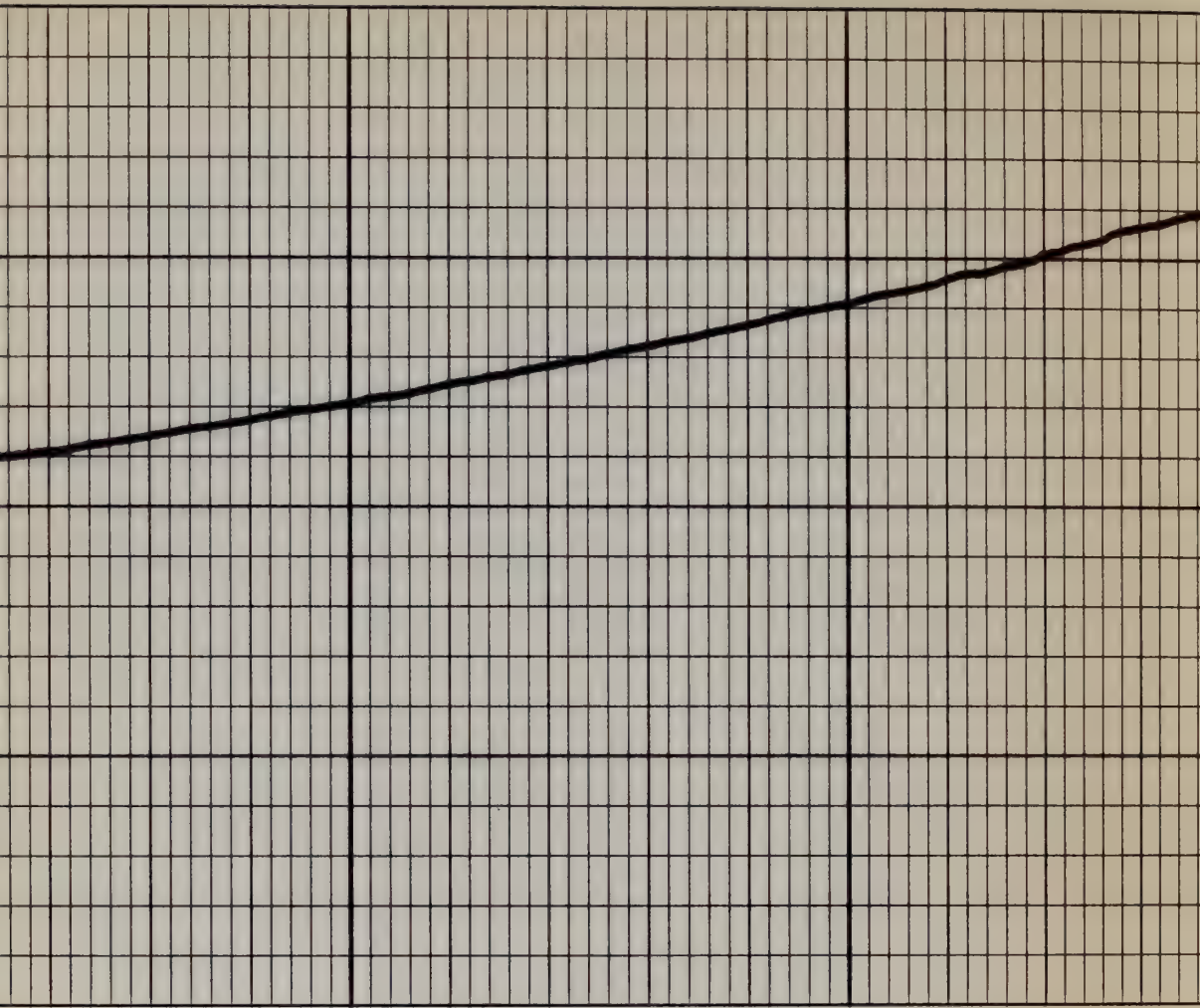
600



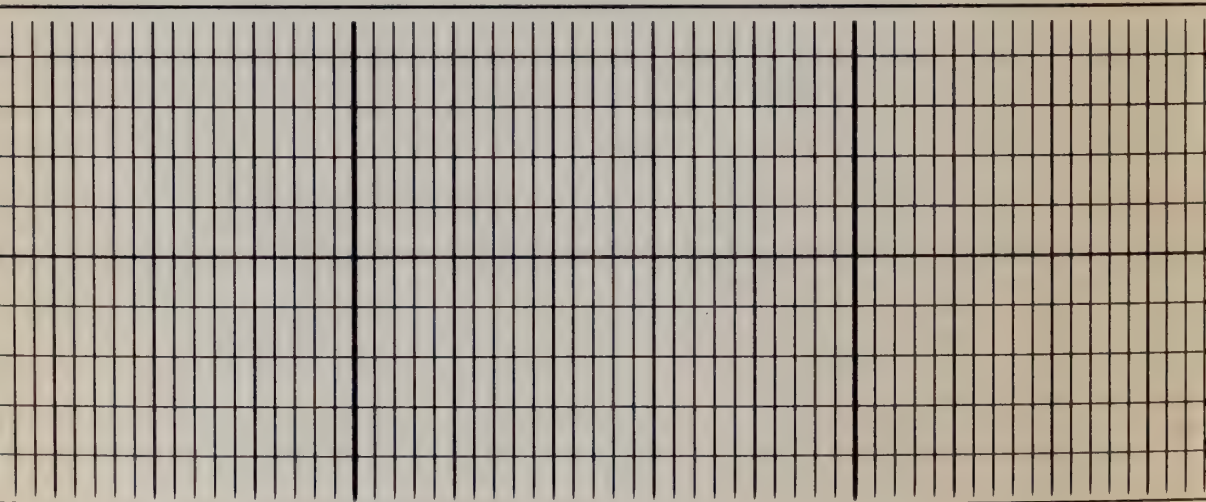


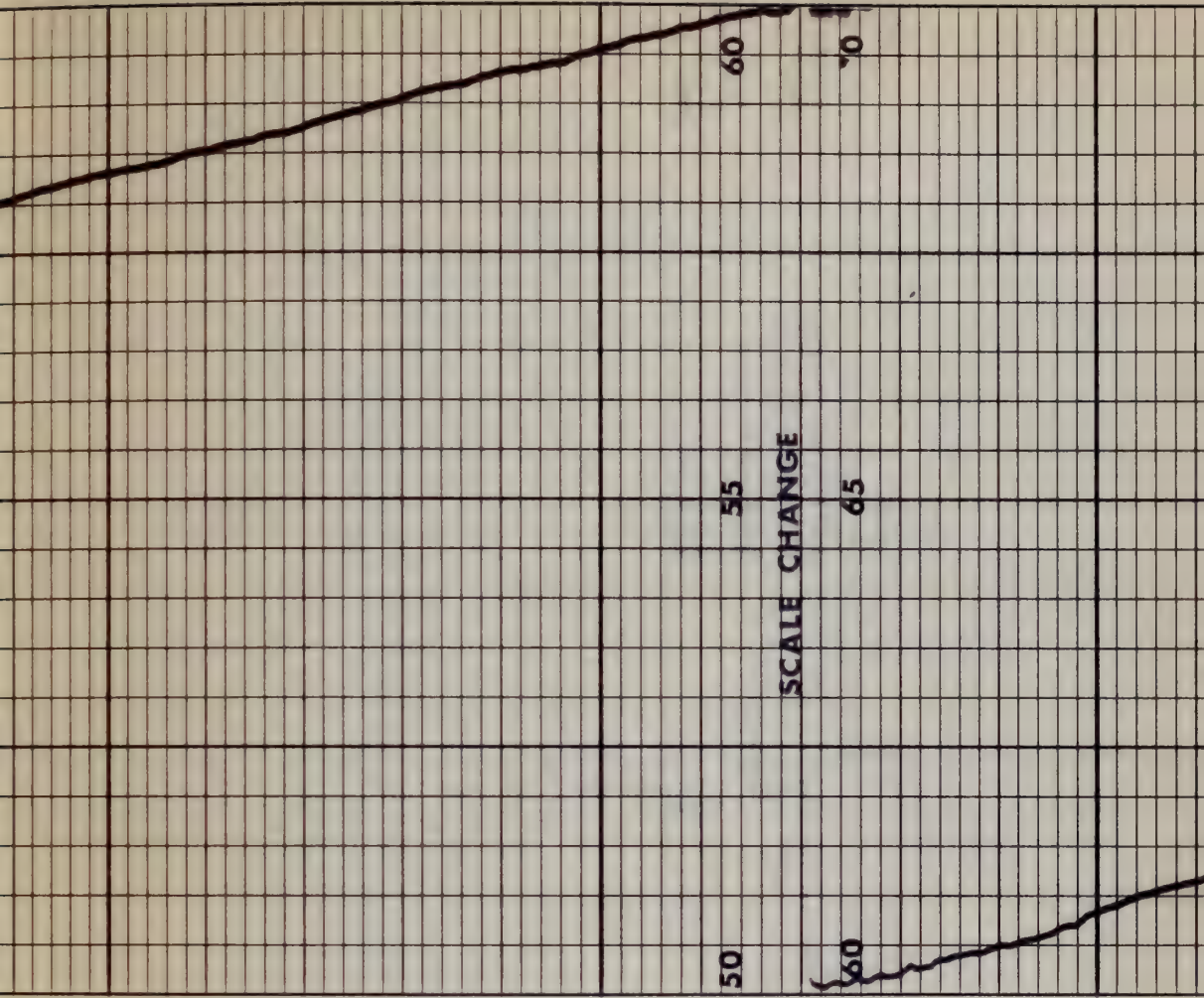
700





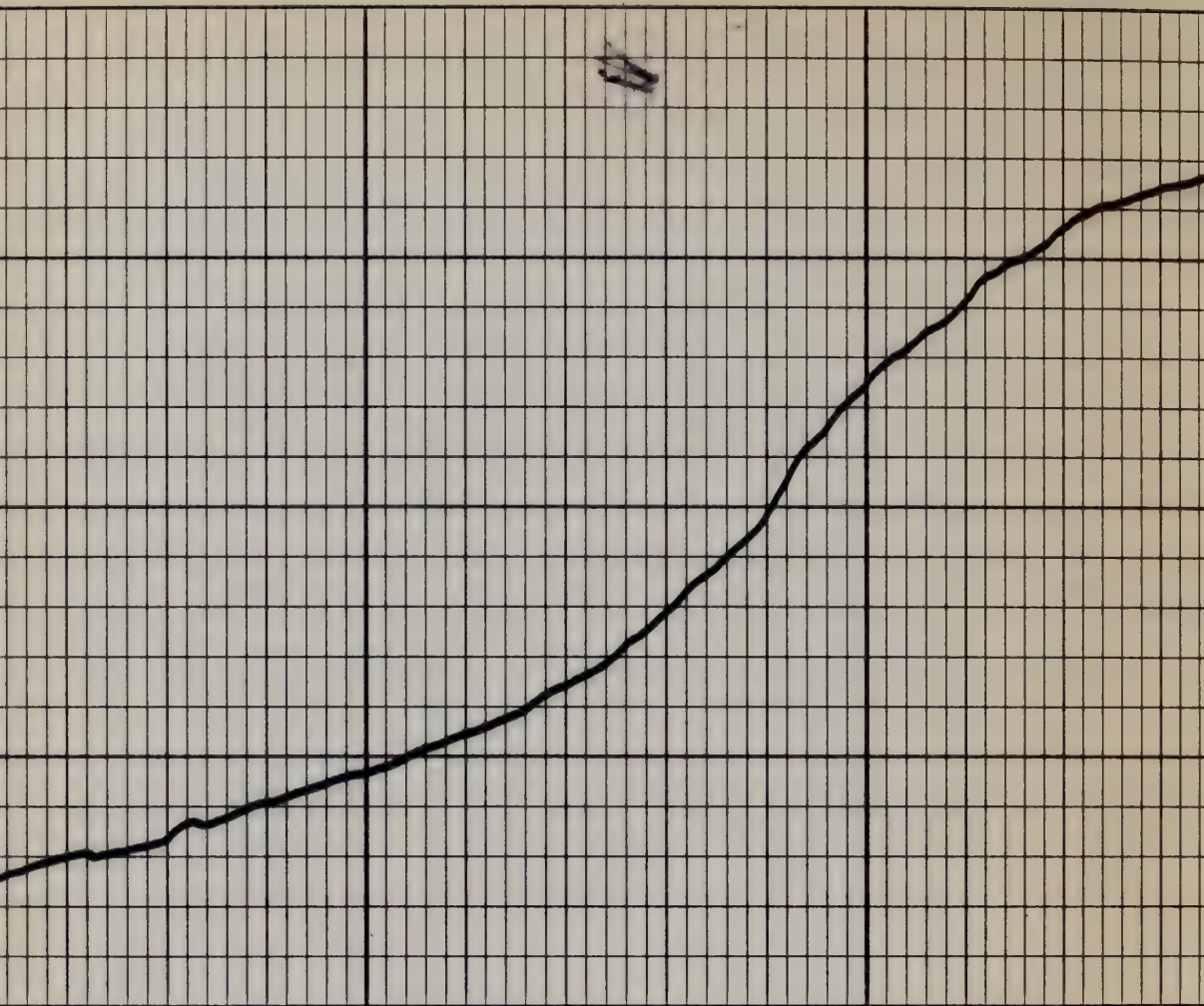
800



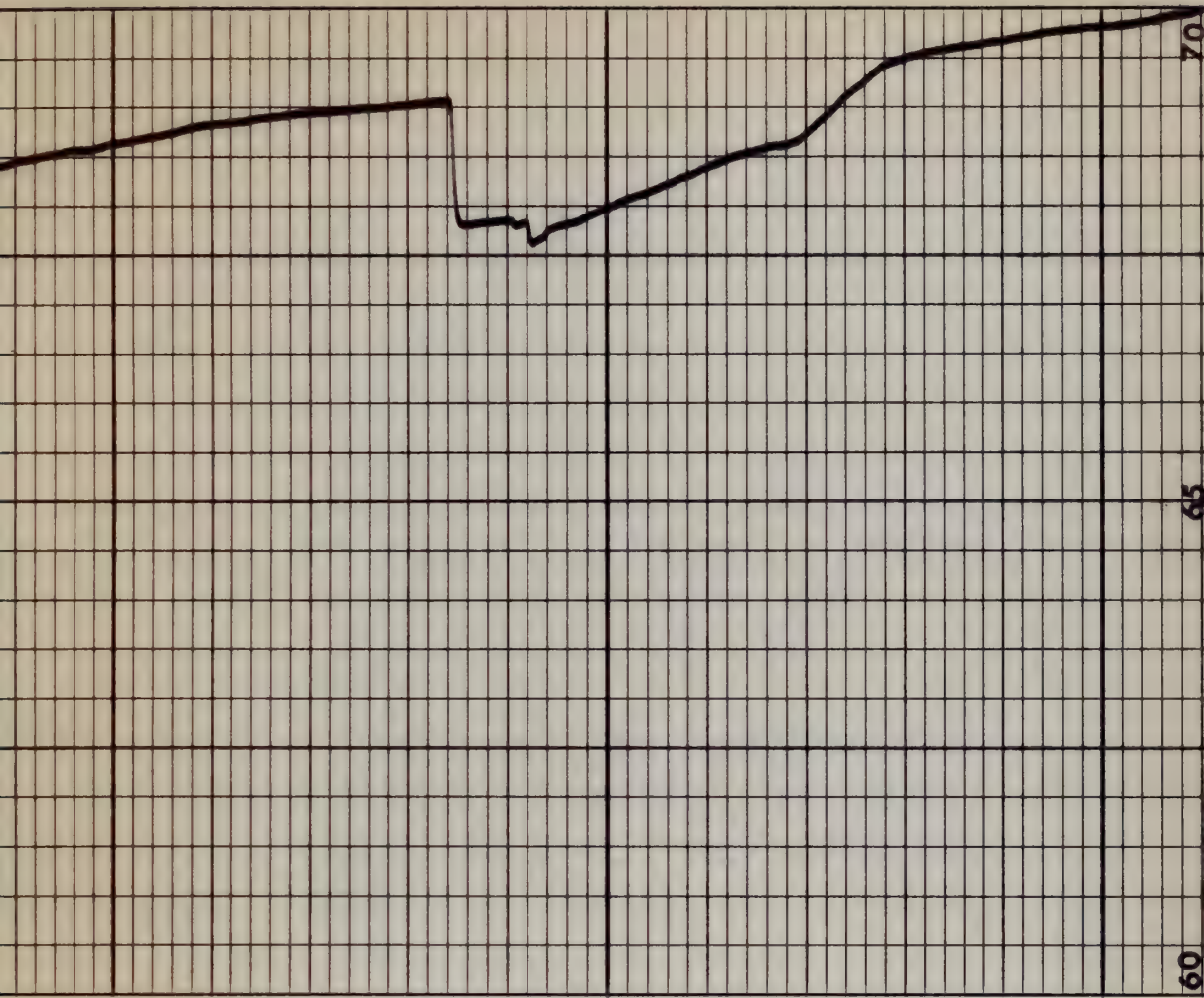


900

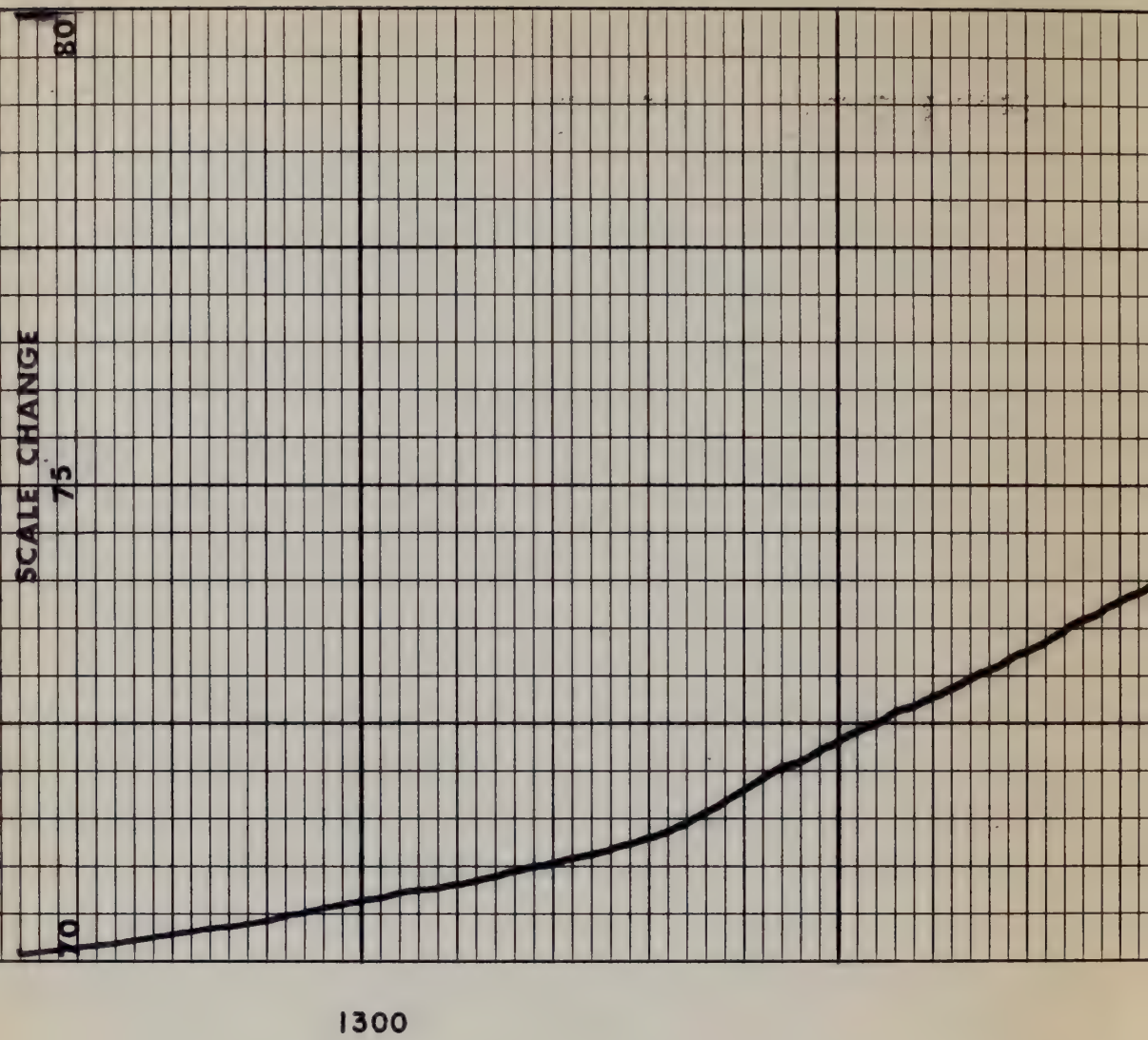
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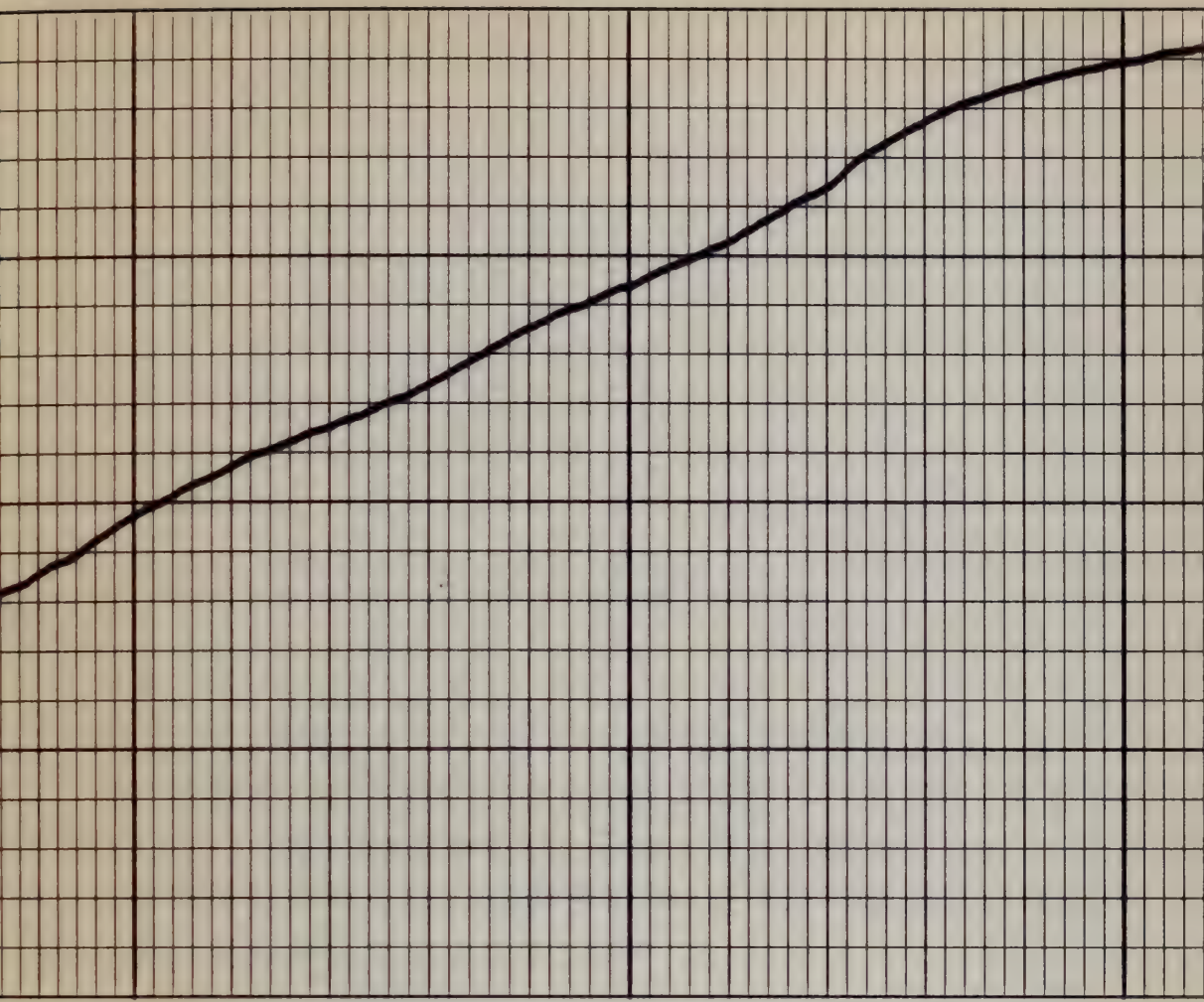


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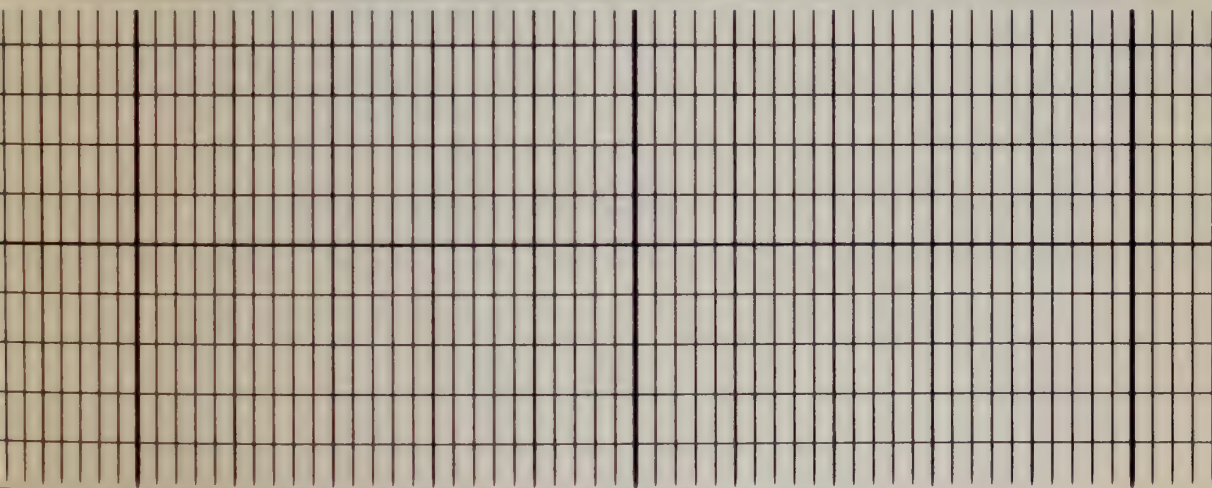
1200

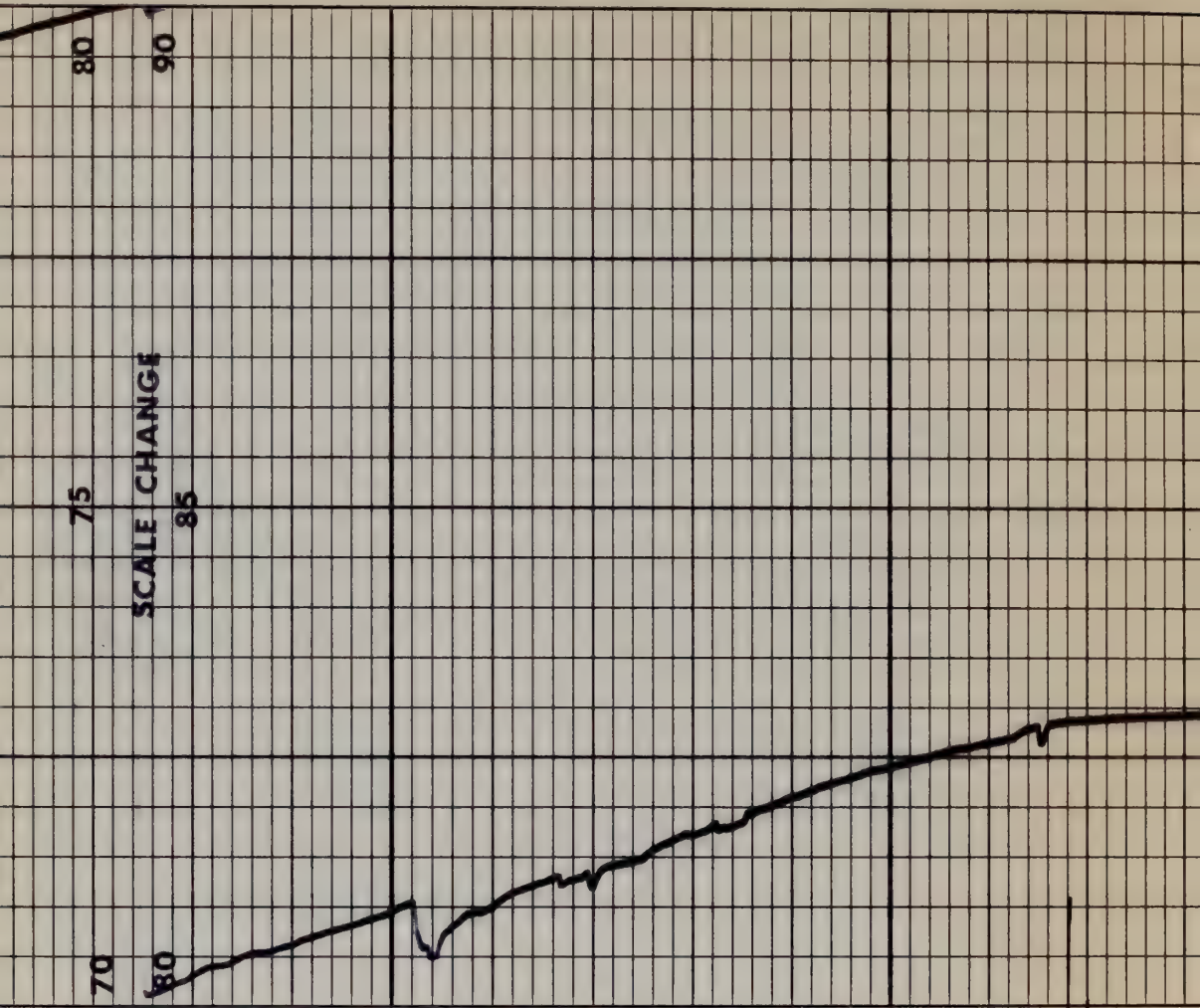




1400

1500





1600

80

85

90

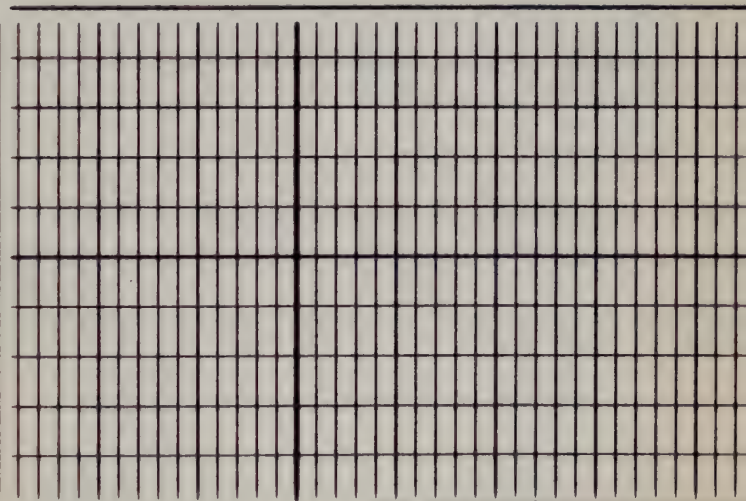
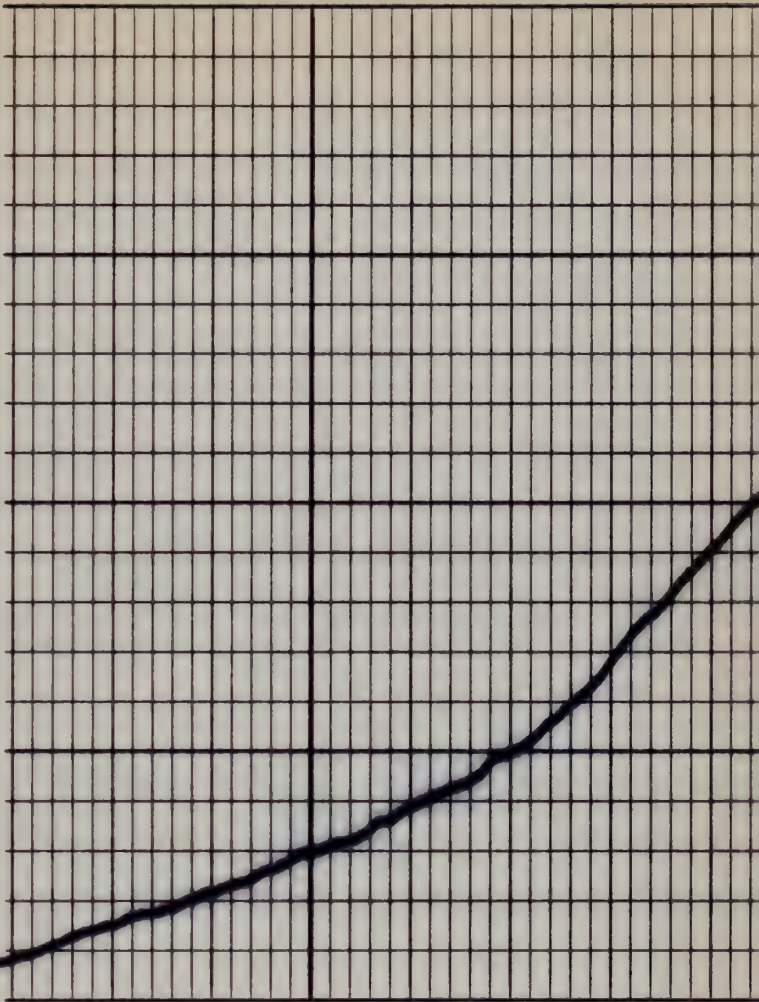
SCALE CHANGE

60

65

70

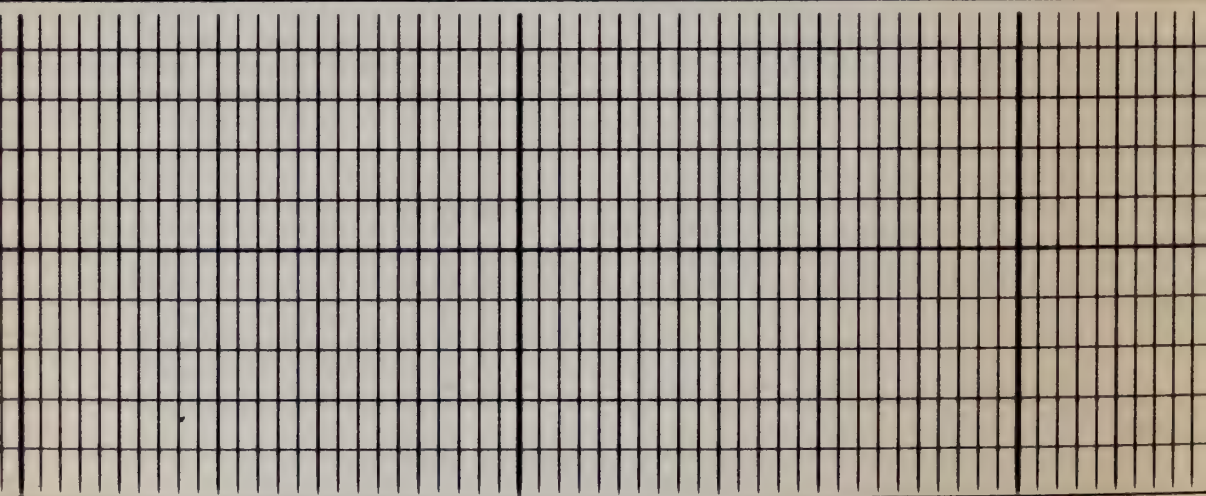
REPEAT SECTION

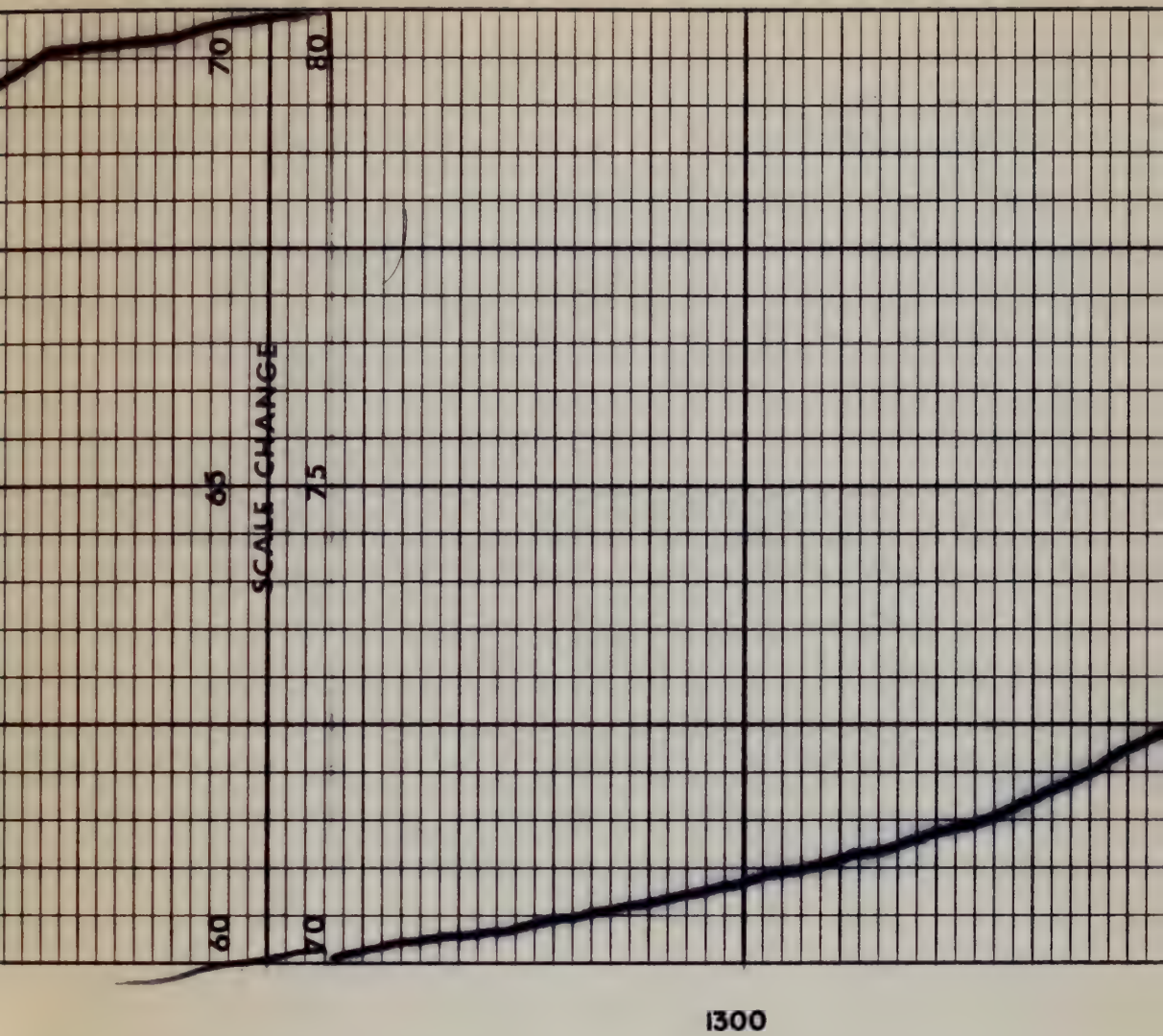


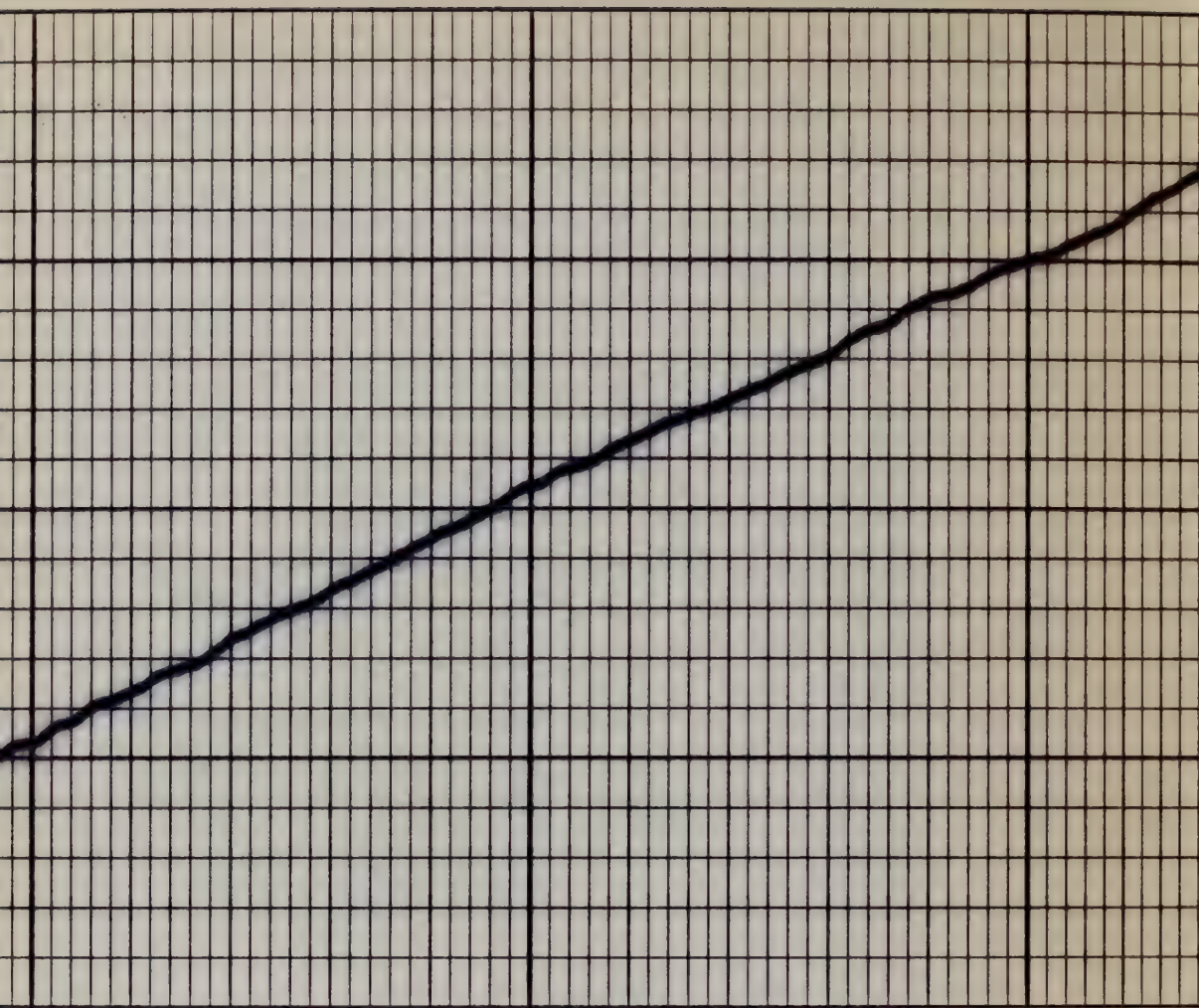


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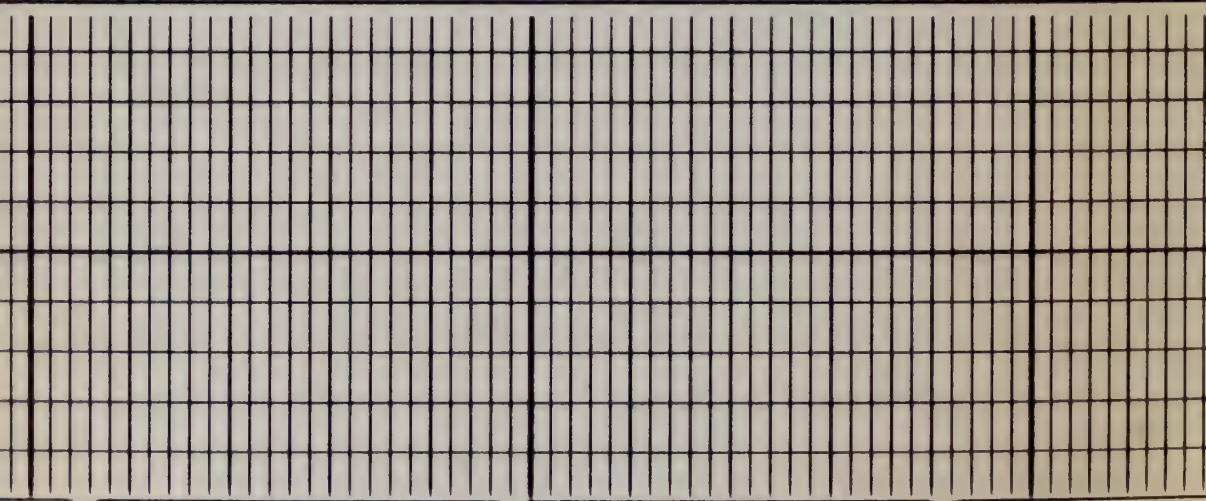
1200

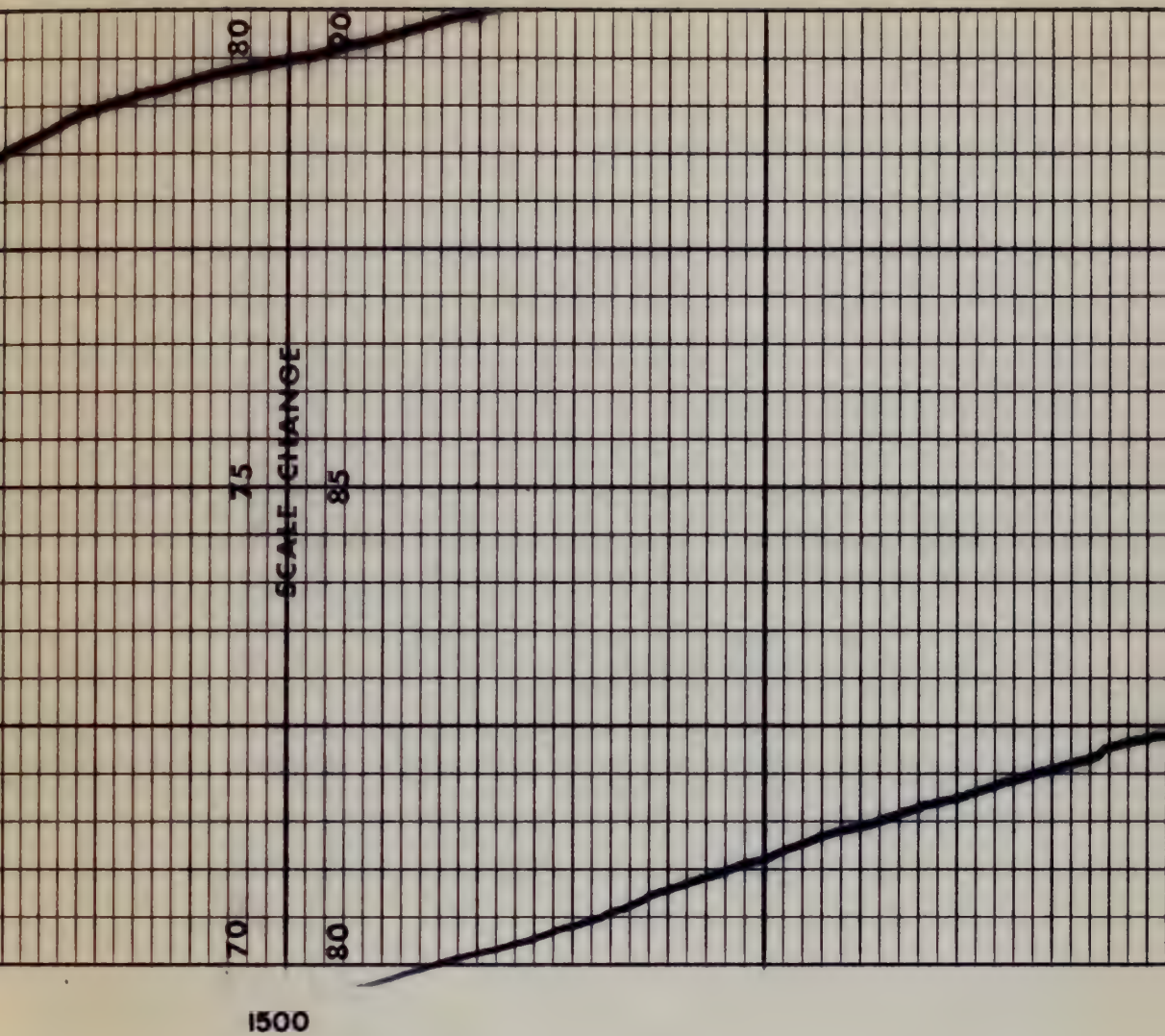


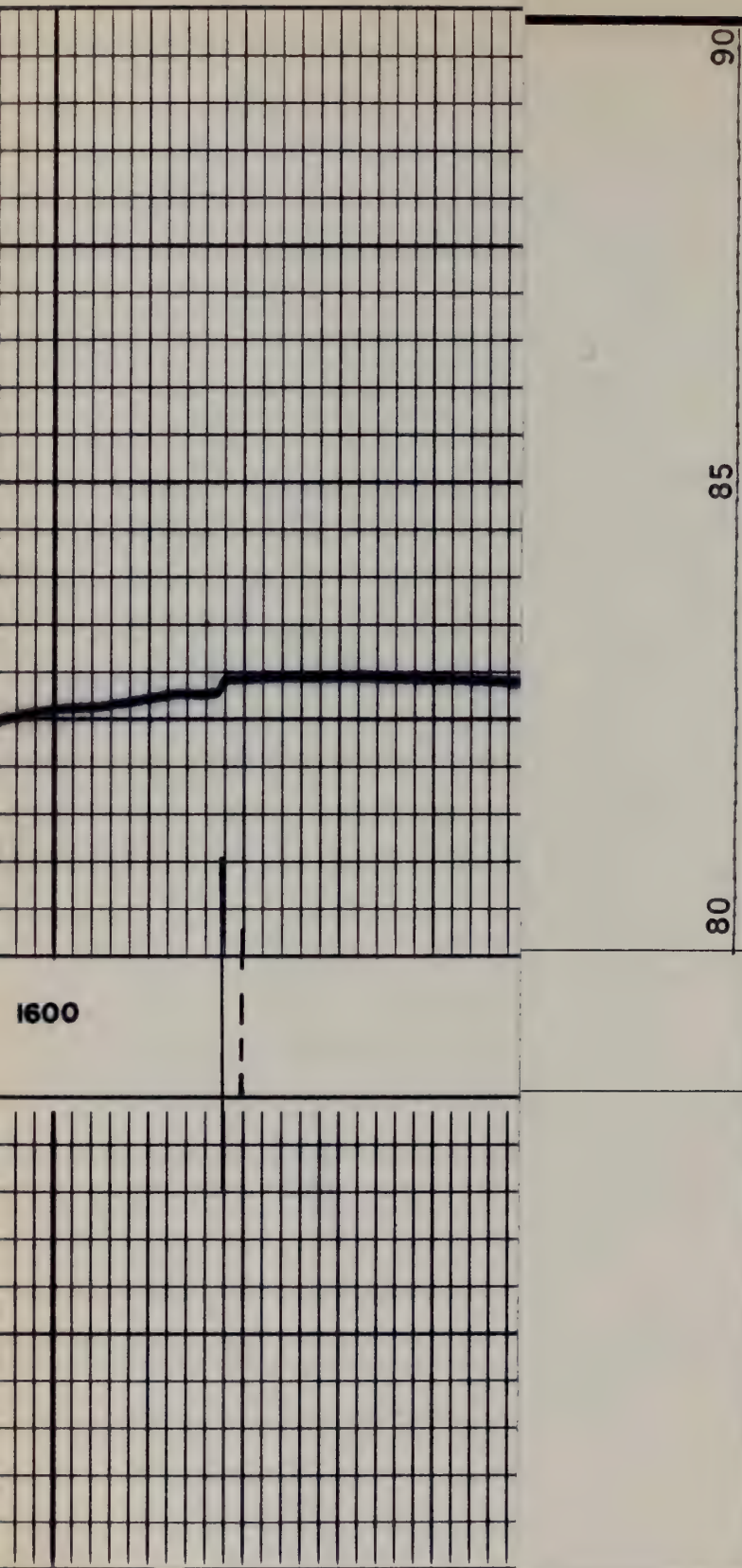




1400







TEMPERATURE ° F.

COMPANY ATLANTIC RICHFIELD COMPANY

WELL SORGUM GULCH AQUIFER NO. 1-A

FIELD

COUNTY RIO BLANCO

STATE COLORADO

SCHL. F. R. 1618

SCHL. T. D. 1620

DRLR. T. D. 1620



Birdwell

3-Dimensional Velocity Log

FILING NO.

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD _____

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

OTHER SERVICES:

CAL FDL ES
TL GR/ENP

SEC. 7 TWP. 3S RGE. 96W

ELEVATIONS

PERMANENT DATUM

GROUND LEVEL ELEV. 6909'

LOG MEASURED FROM

GL

DRILLING MEASURED FROM

GL

KB. _____

DF. _____

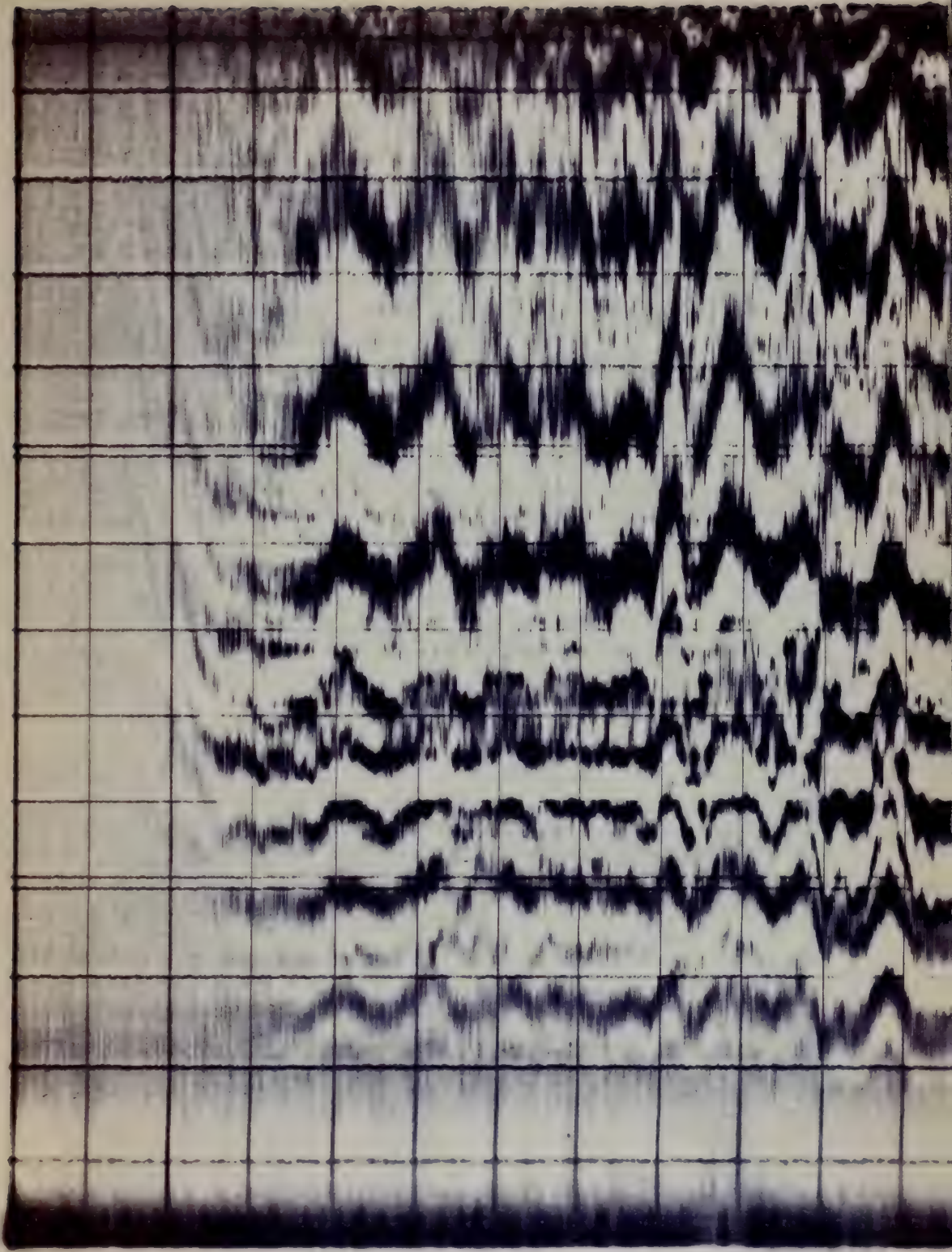
GL. 6909'

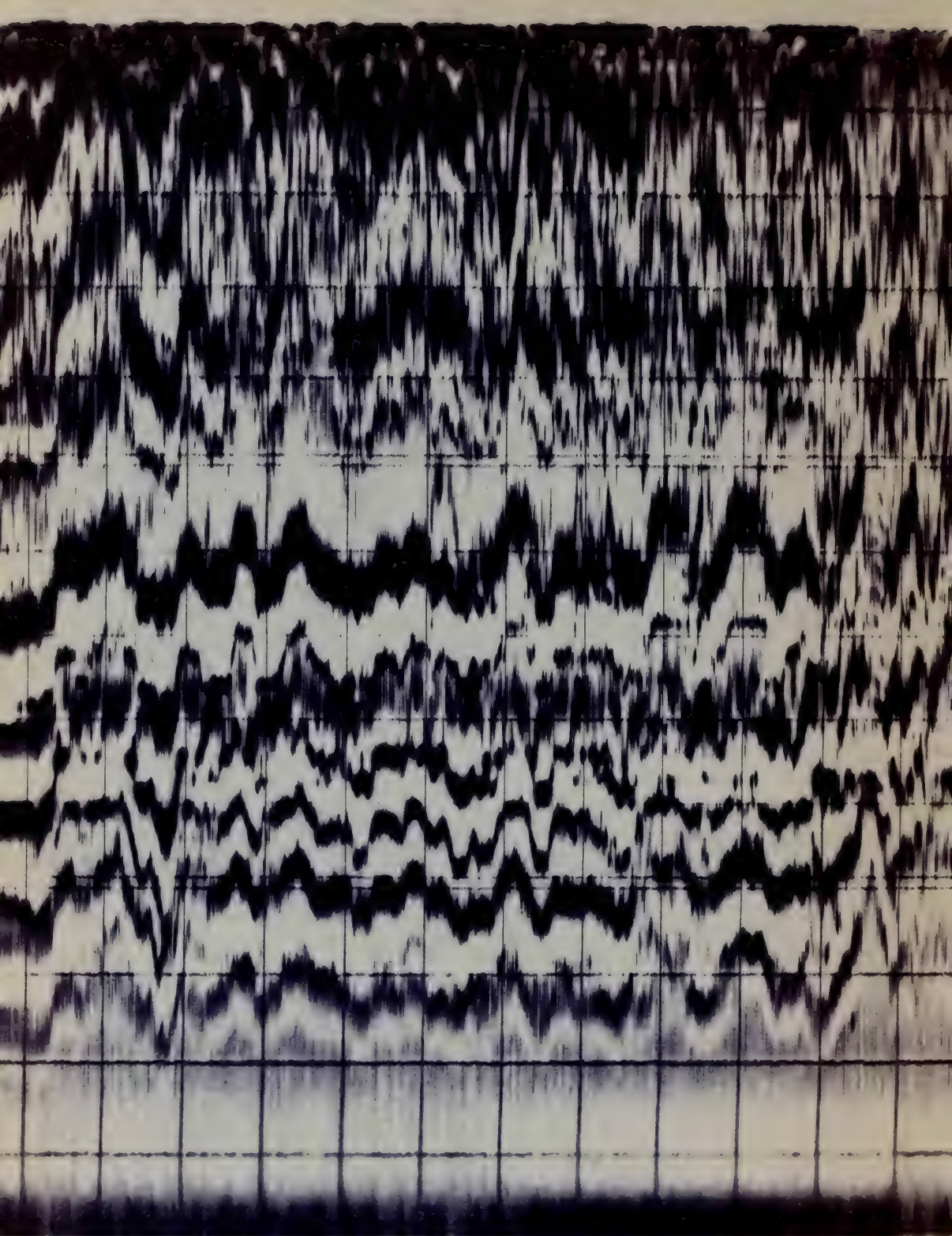
DATE	2 JULY 74	2 JULY 74	
RUN NO.	2	2	
TYPE LOG—BOND OR VEL.	V3D	V3D	
DEPTH — DRILLER	1621	1621	
DEPTH — LOGGER	1620	1620	
BOTTOM LOGGED INTERVAL	1610	1610	
TOP LOGGED INTERVAL	400	400	
TYPE FLUID IN HOLE	WATER	WATER	
SALINITY PPM CL.			
DENSITY LB./GAL.			
LEVEL	412	412	
MAX. REC. TEMP. — DEG. F.	78°	78°	
OPR. RIG TIME	1 HR.	1 HR.	
RECORDED BY	WILSON	WILSON	
WITNESSED BY	TAIT	TAIT	
LOCATION	LAS VEGAS	LAS VEGAS	

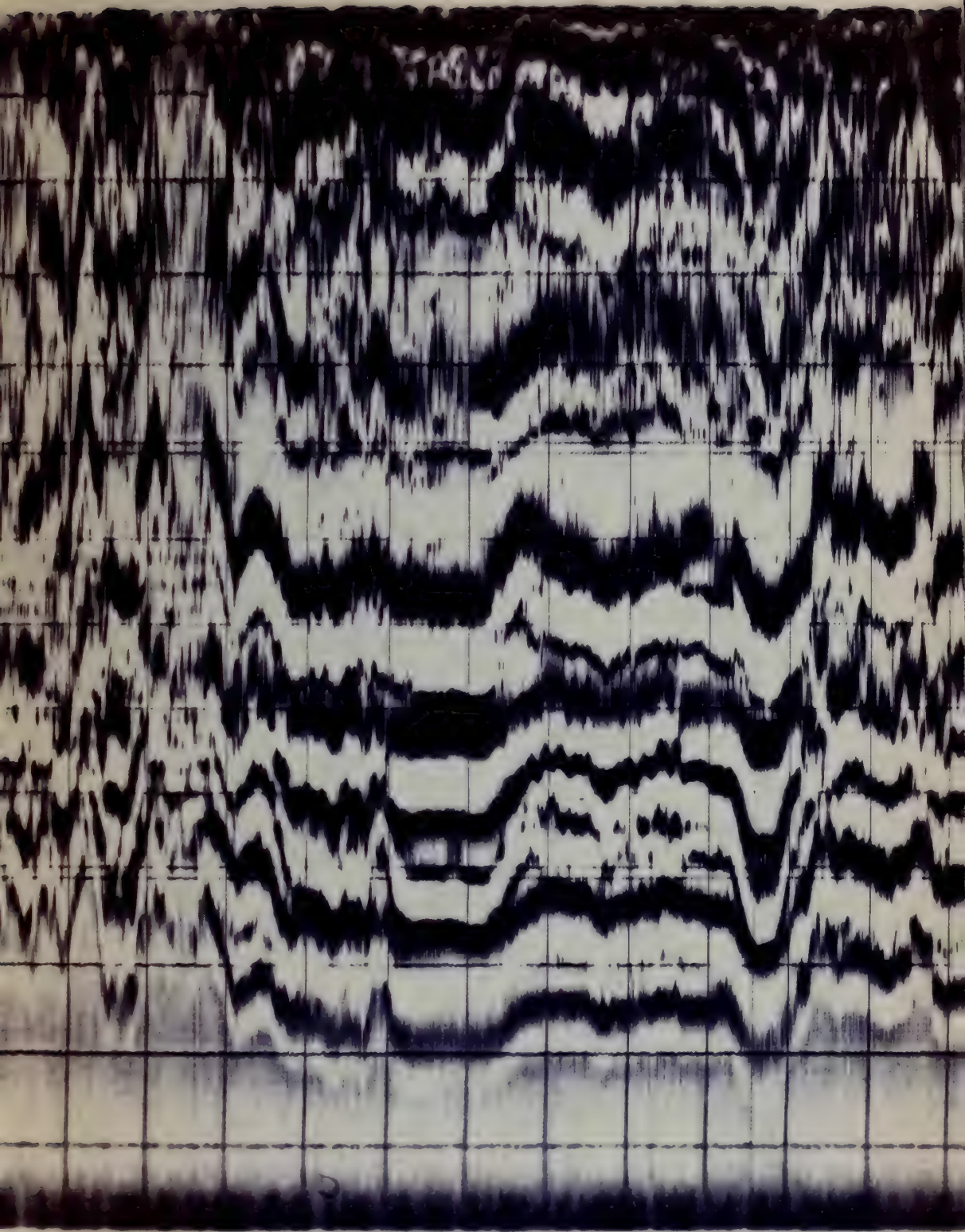
RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	5-1/4"	62'	1621'	7"		0	62'

EQUIPMENT DATA			
SURFACE		SUB-SURFACE	
RUN NO.	1	2	RUN NO.
CAMERA MODEL NO.	LLAD	LLAD	TX TRANSDUCER SIZE
SWEEP DELAY - μ SEC.	0	100	ISOLATOR LENGTH
TOTAL SWEEP TIME - μ SEC.	2000	2000	CENTER TO CENTER
LOGGING SPEED FT./MIN.			BUMPER O.D.
DEPTH SCALE FT./MARK			BOREHOLE GAIN - /DB
TIMING LINES	100	100	
GENERAL		CEMENTING DATA	
HOIST TRUCK NO.	2694	2694	DATE, PRIMARY
INST. TRUCK NO.	2694	2694	TYPE CEMENT
STATION	LAS VEGAS	LAS VEGAS	AMOUNT
			ADDITIVES BY %
WELL DATA			
TYPE WELL			DATE, SQUEEZE
COMPLETION DATE			TYPE CEMENT
WELL DRILLED WITH	ROTARY <input checked="" type="checkbox"/> CABLE T. <input type="checkbox"/>		AMOUNT
			ADDITIVES BY %
REMARKS			

_____ MICROSECONDS INCREASING _____	
DEPTH	RUN # 1 3' SPACING
500	1000

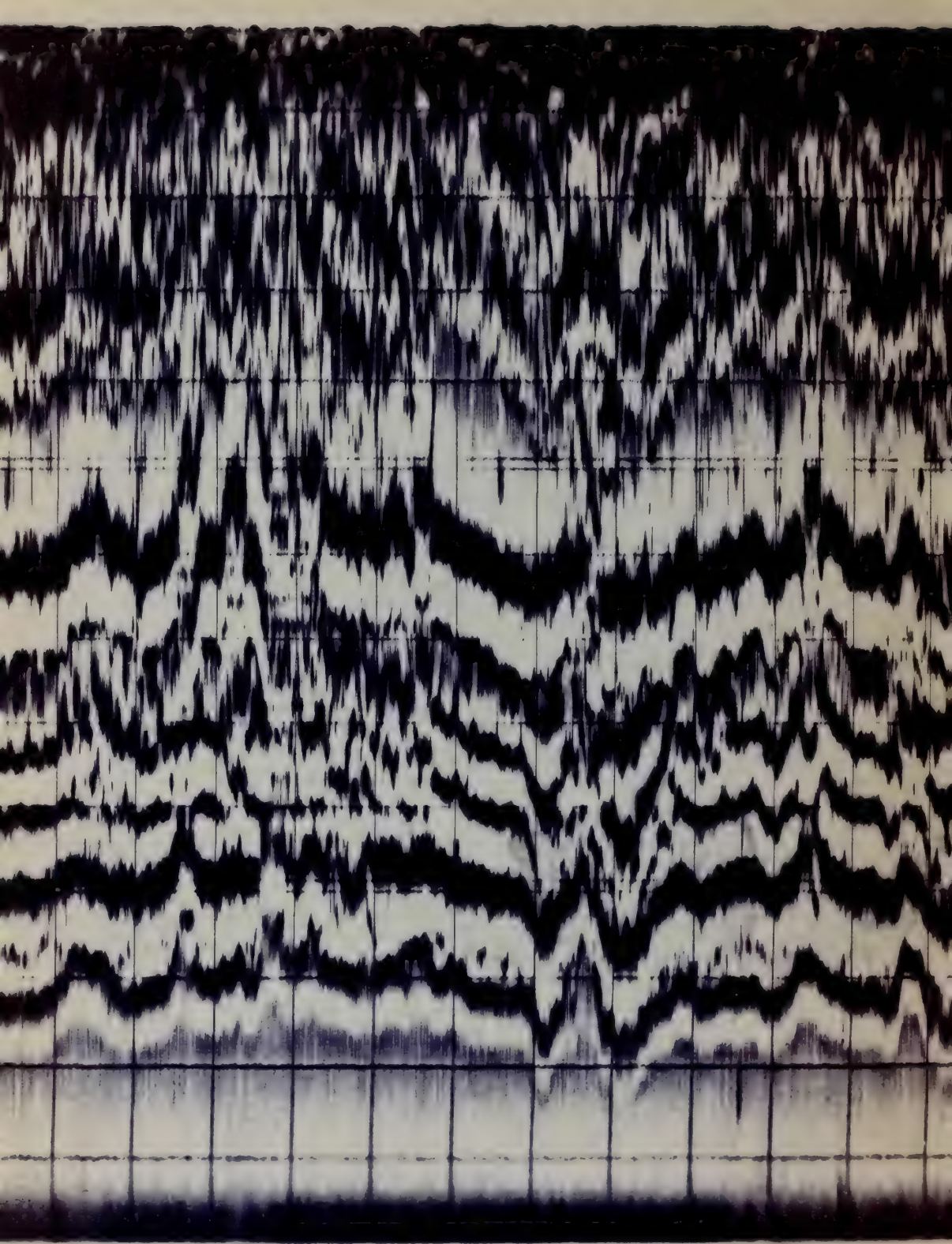


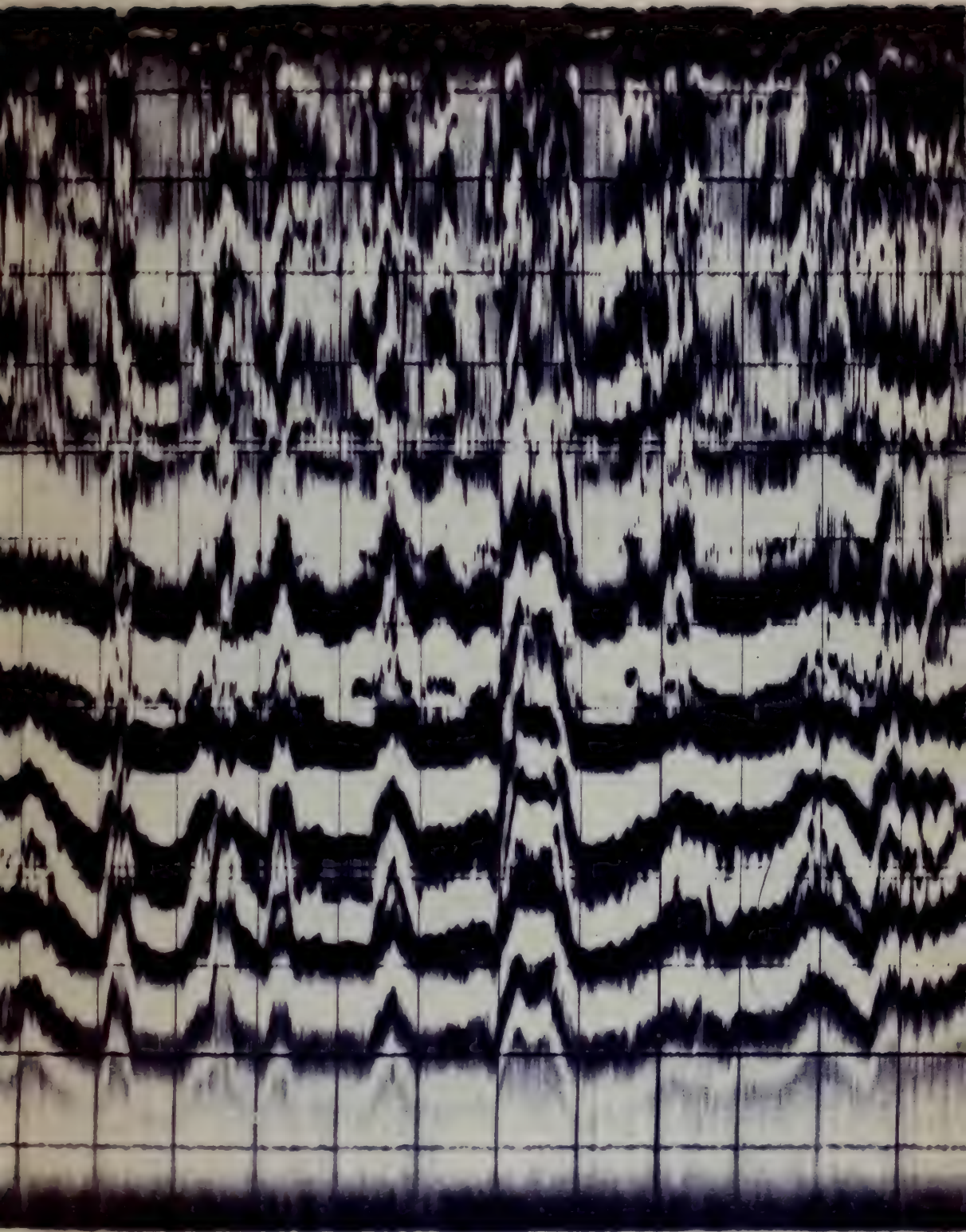


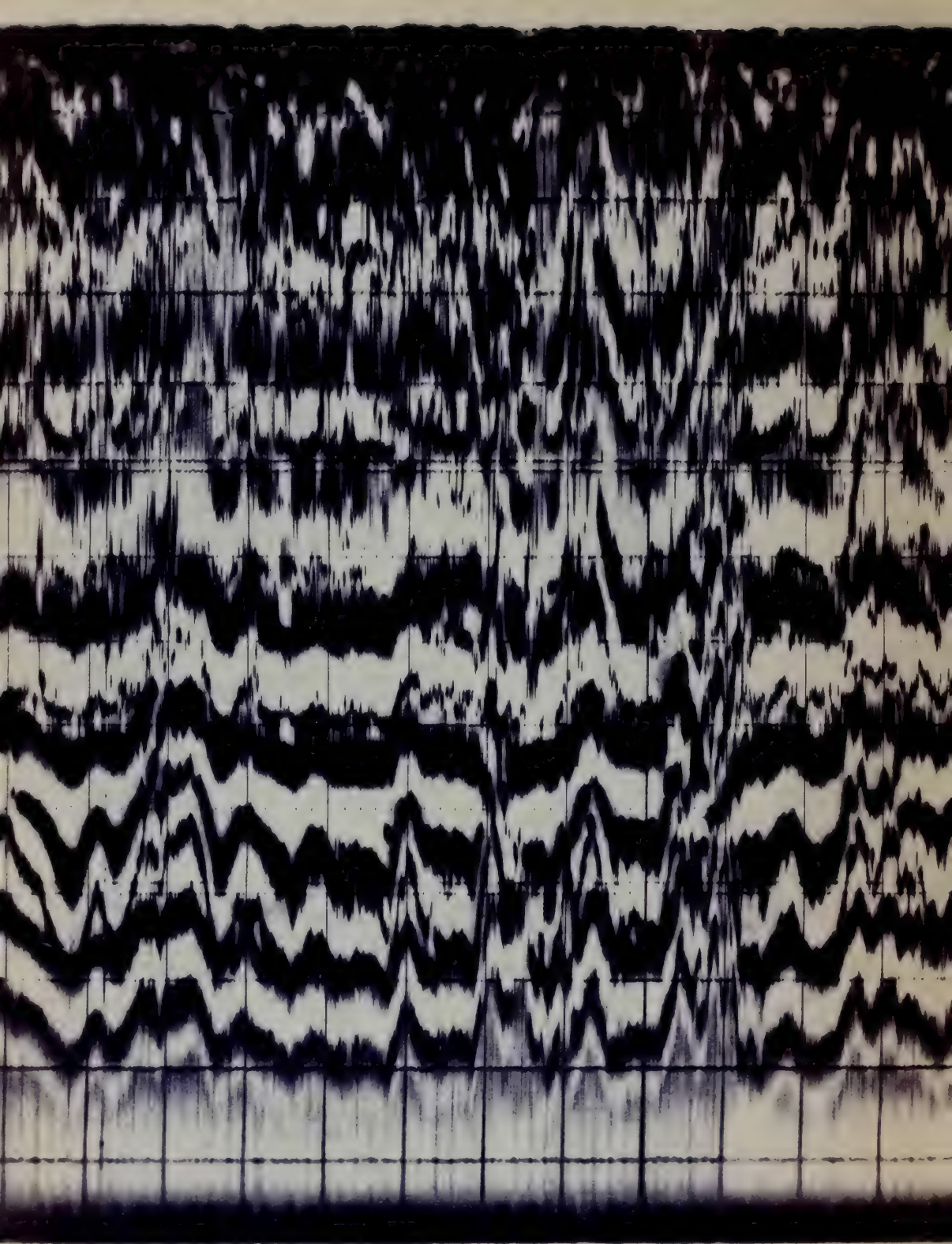


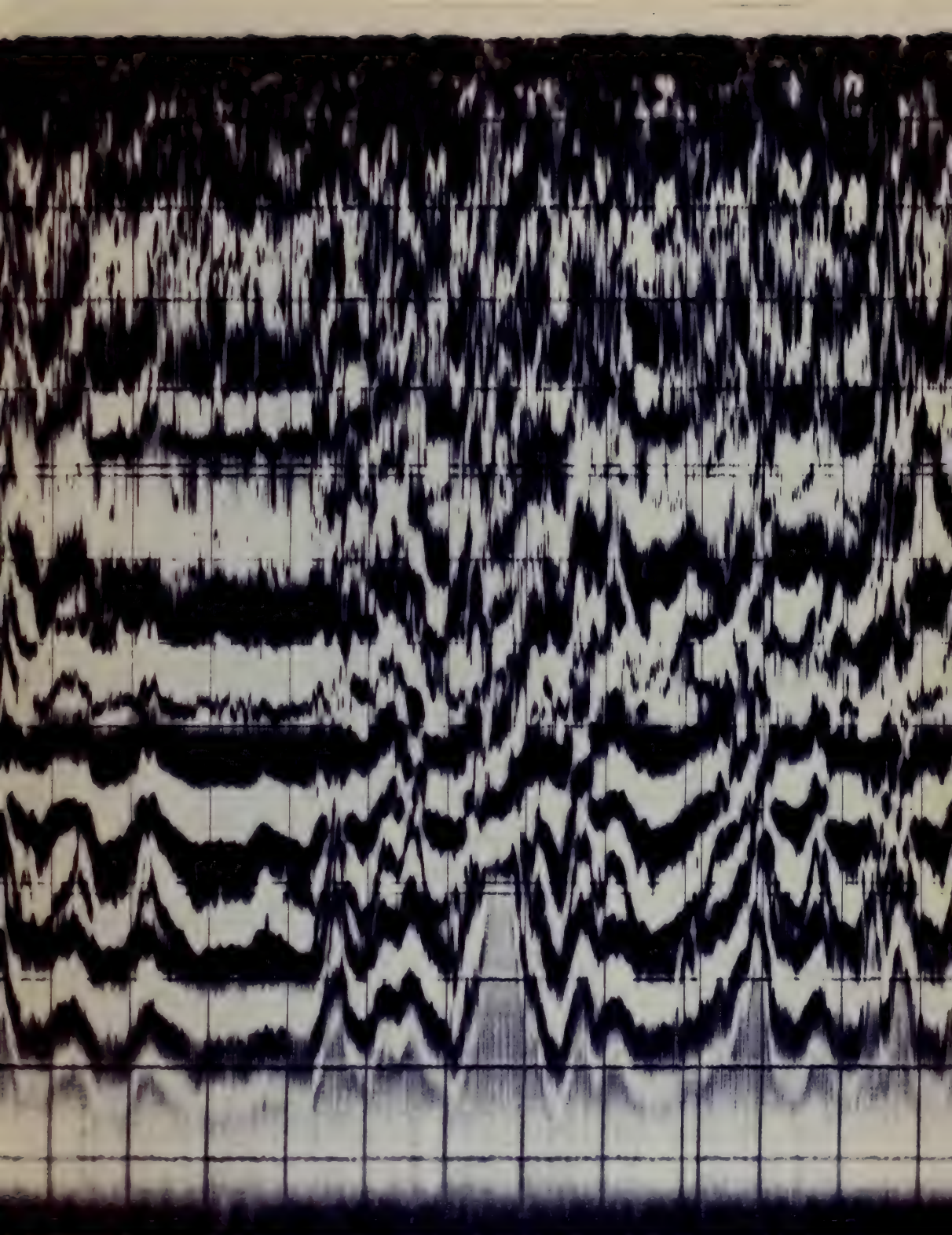
2

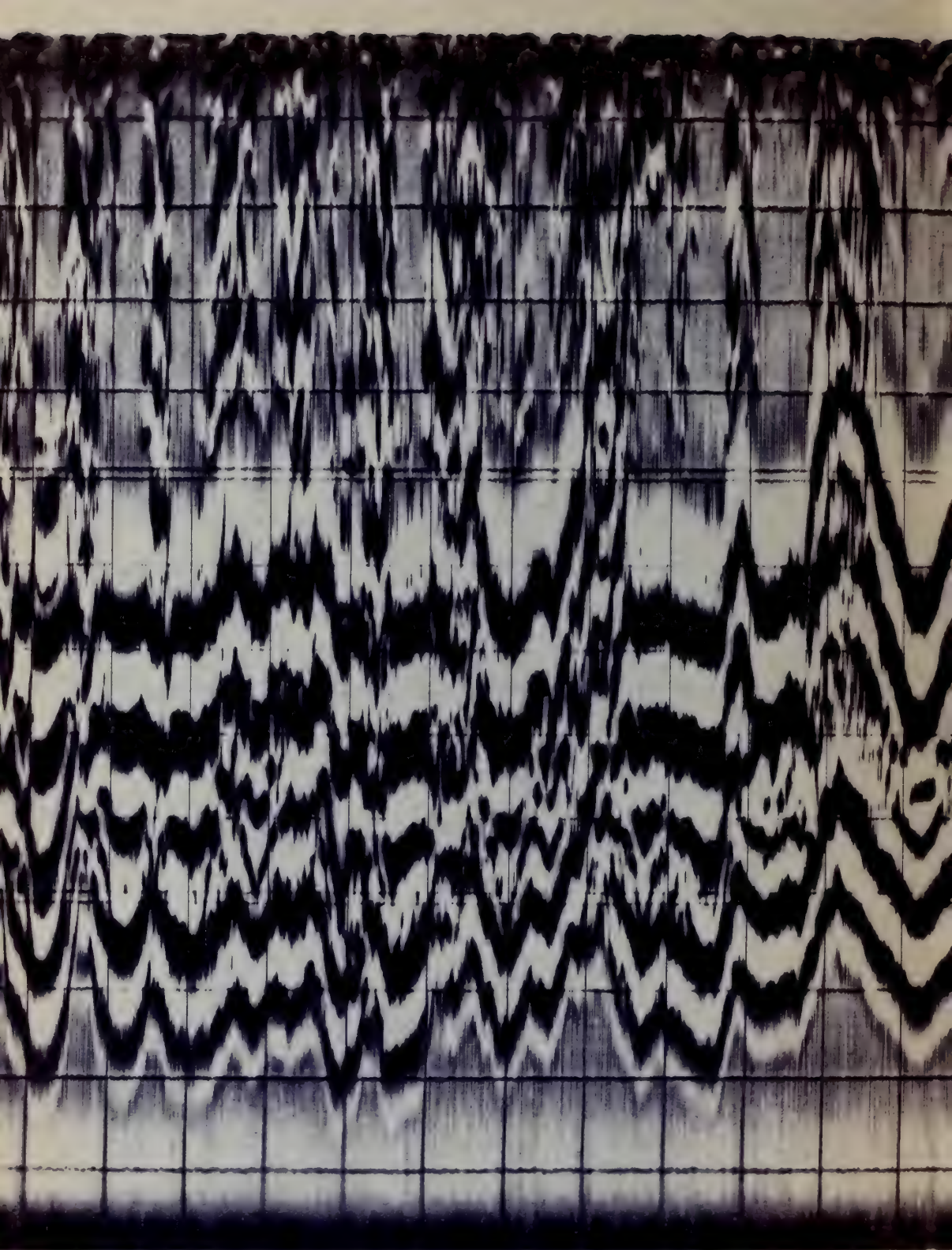
700

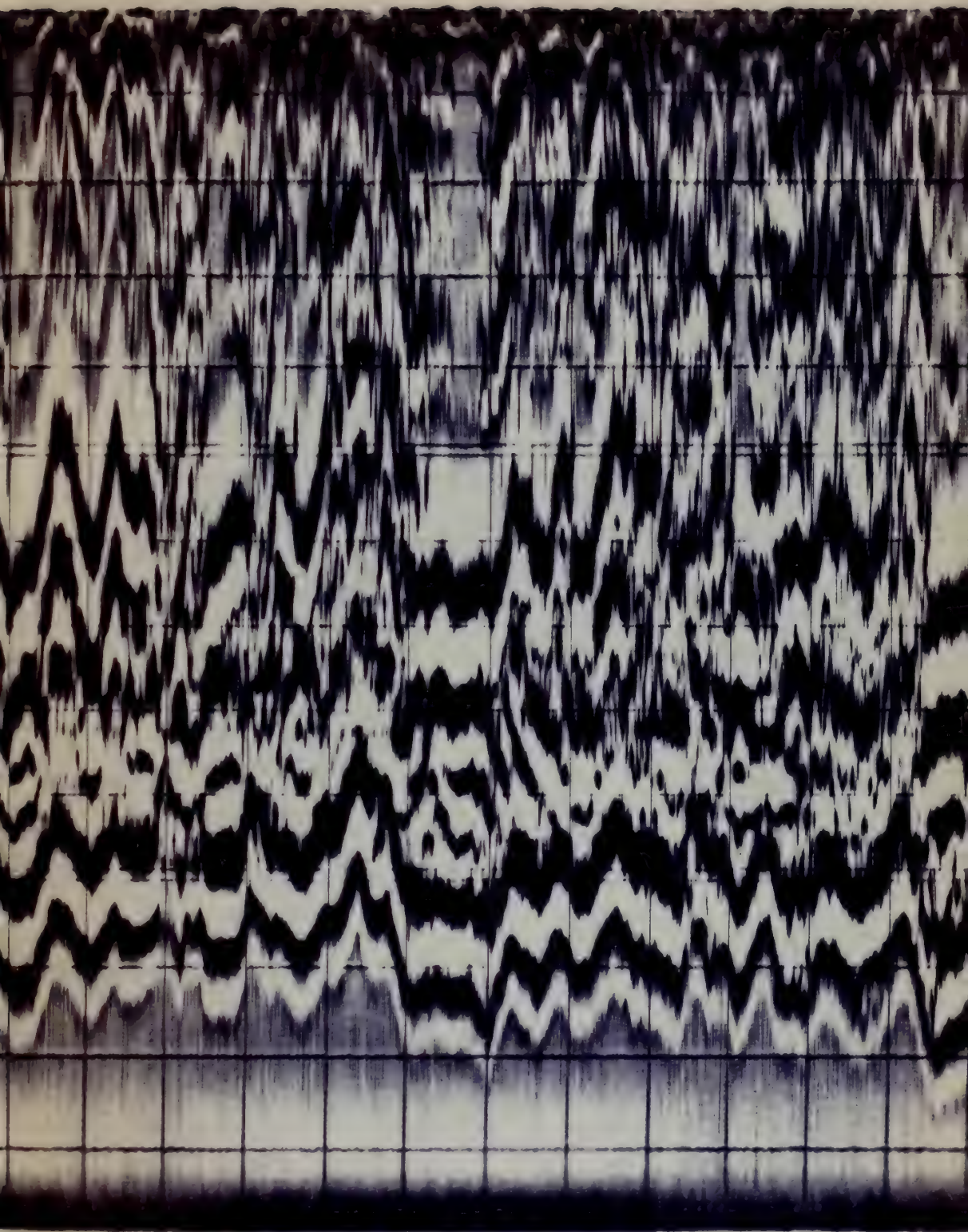


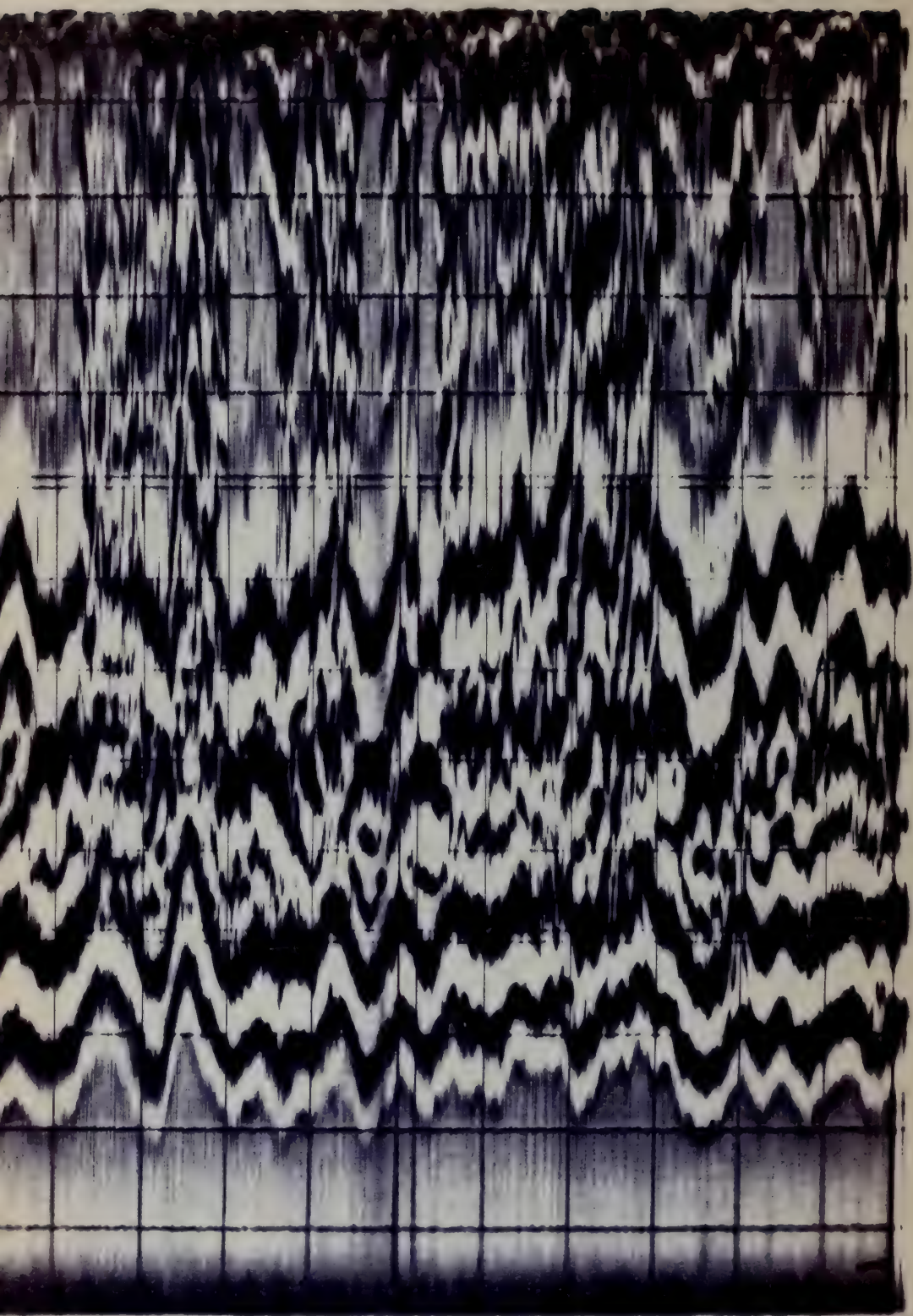












1600

2.5.

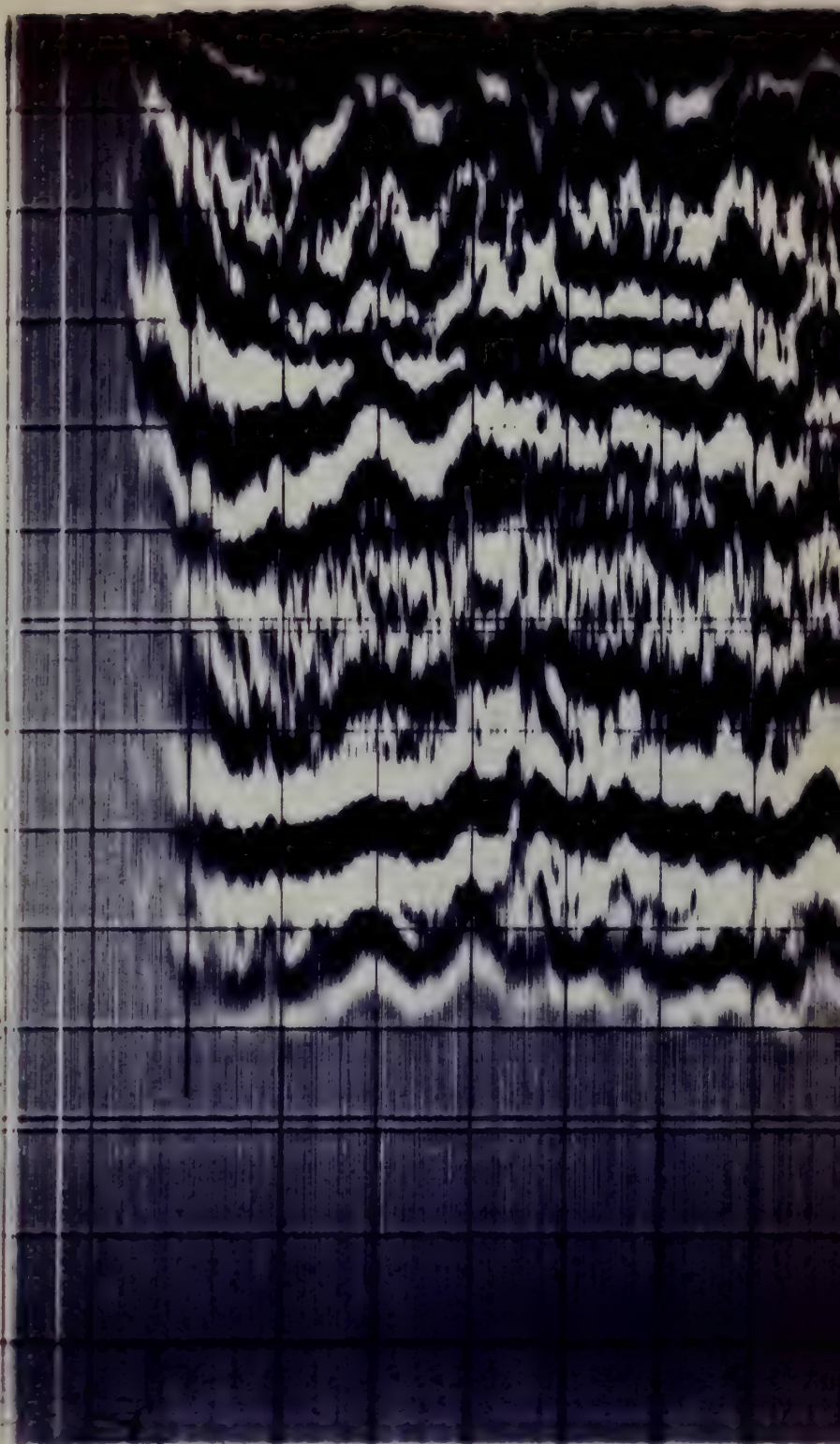
1620'

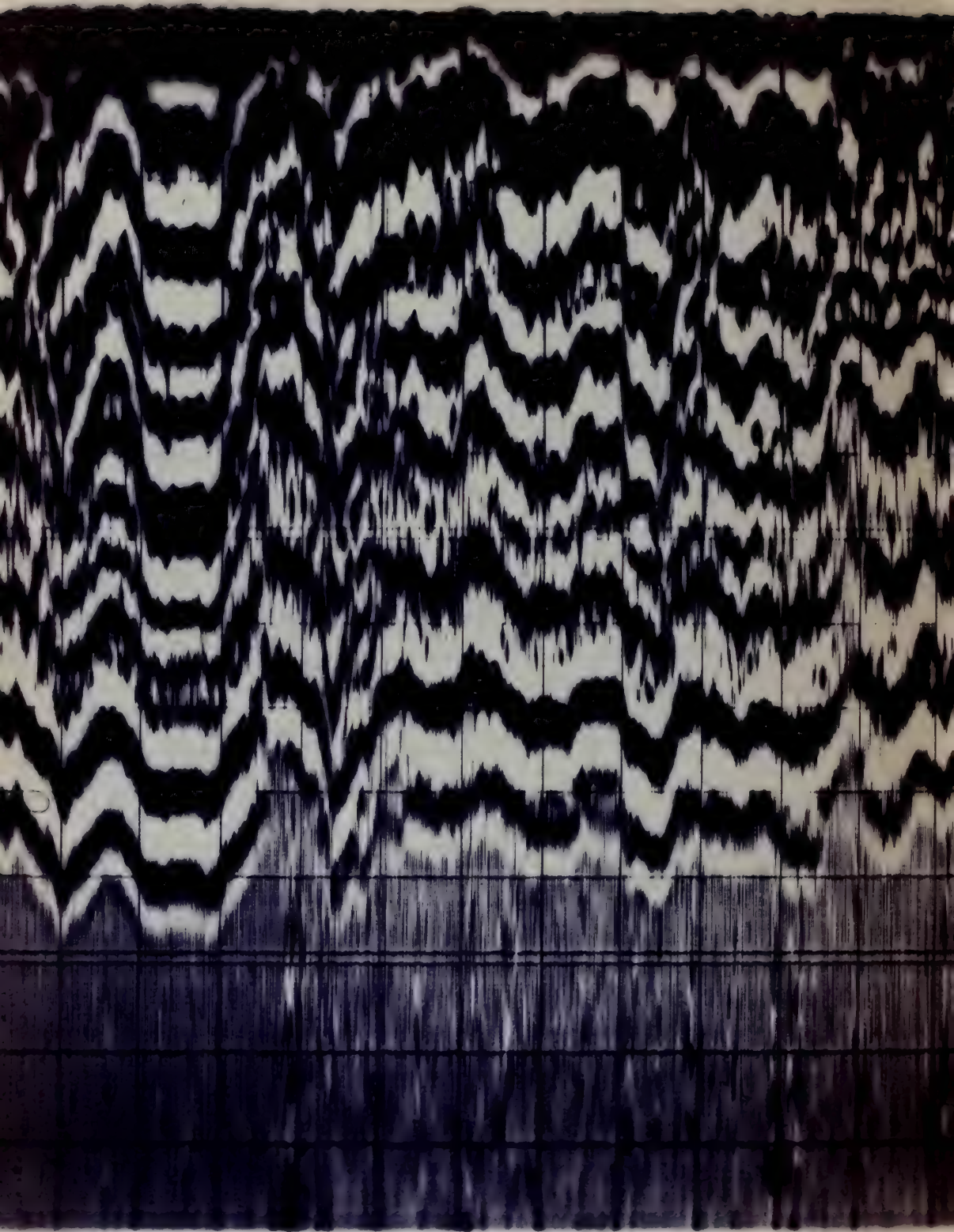
6' SPACING

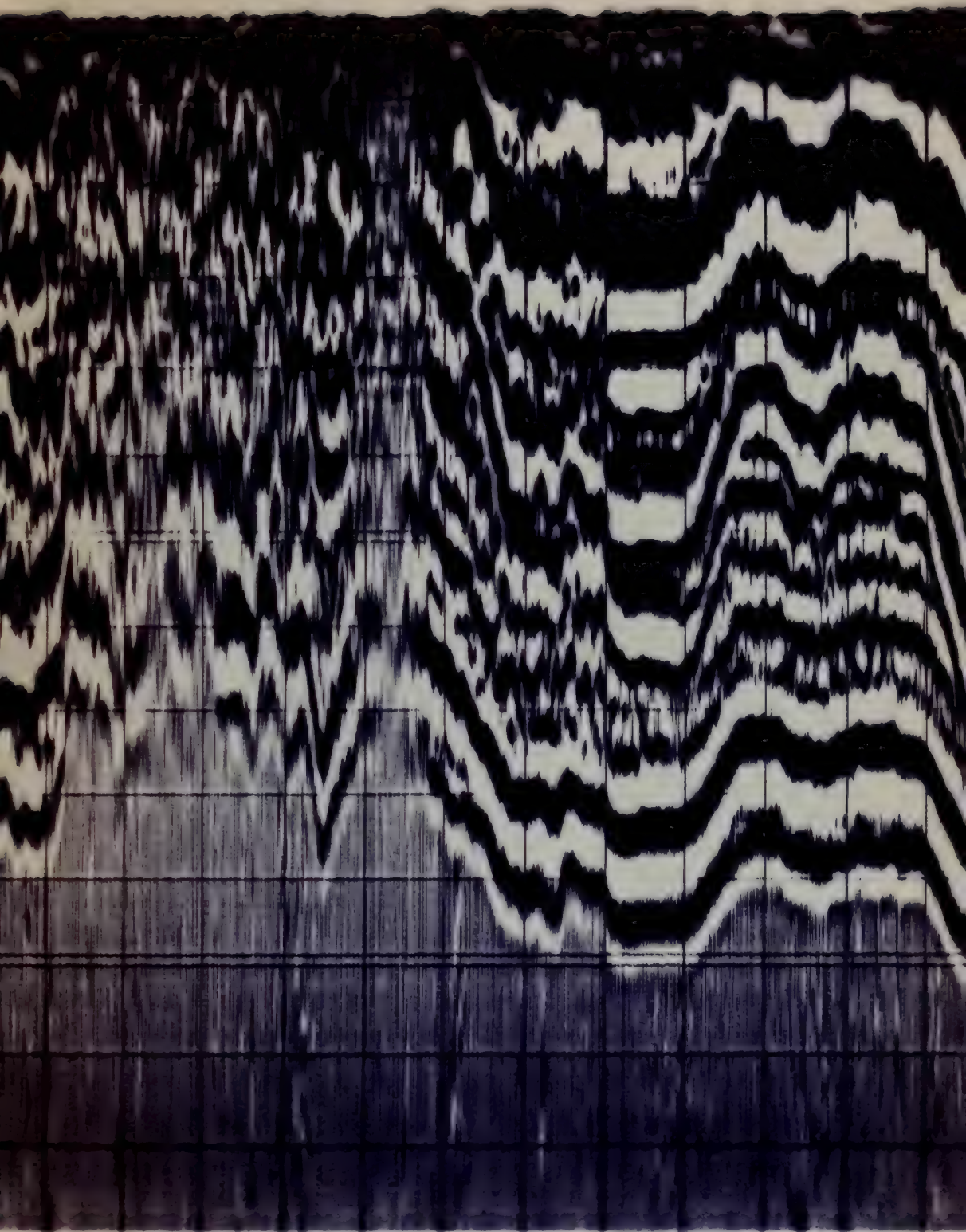
1000

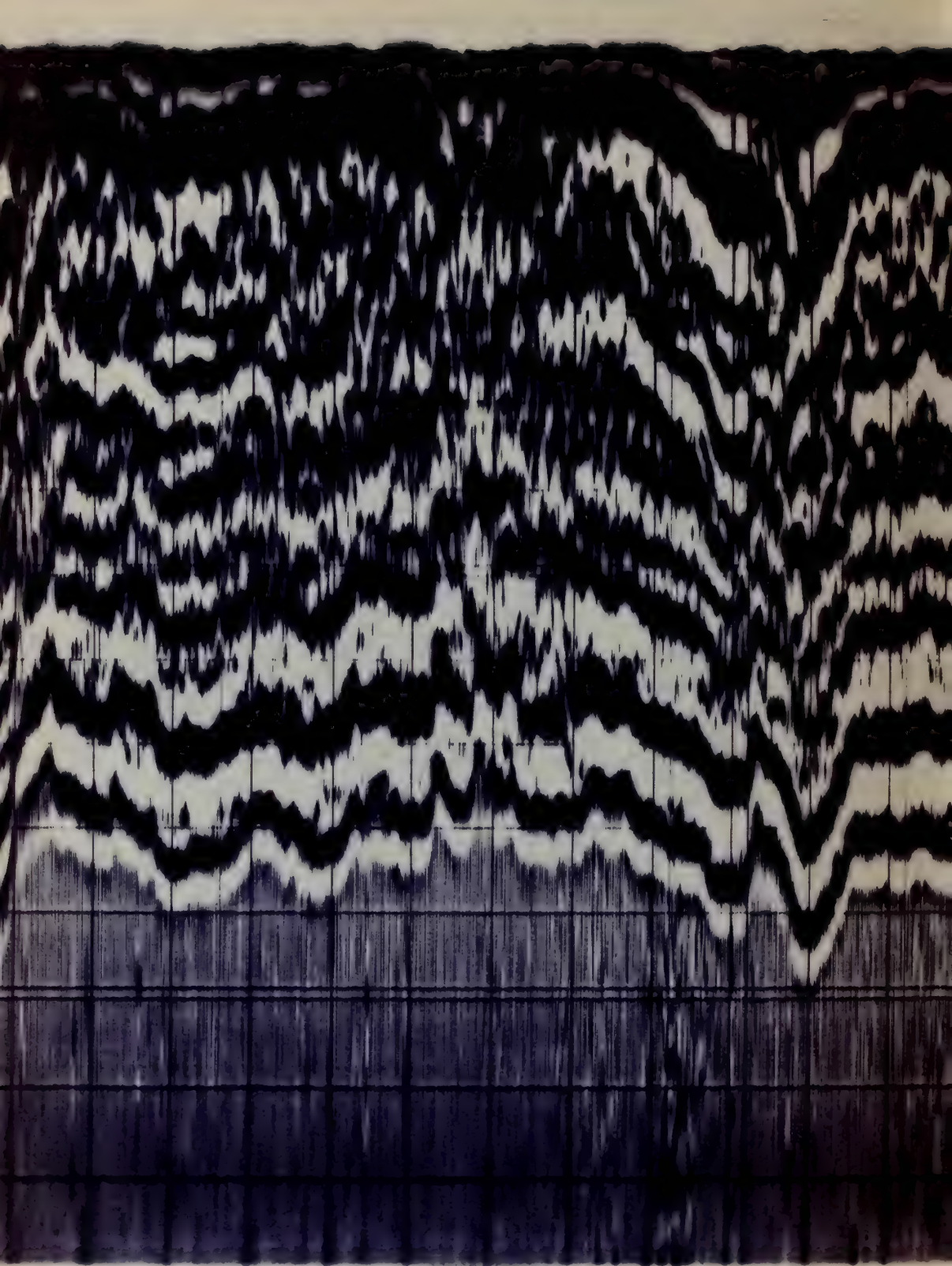
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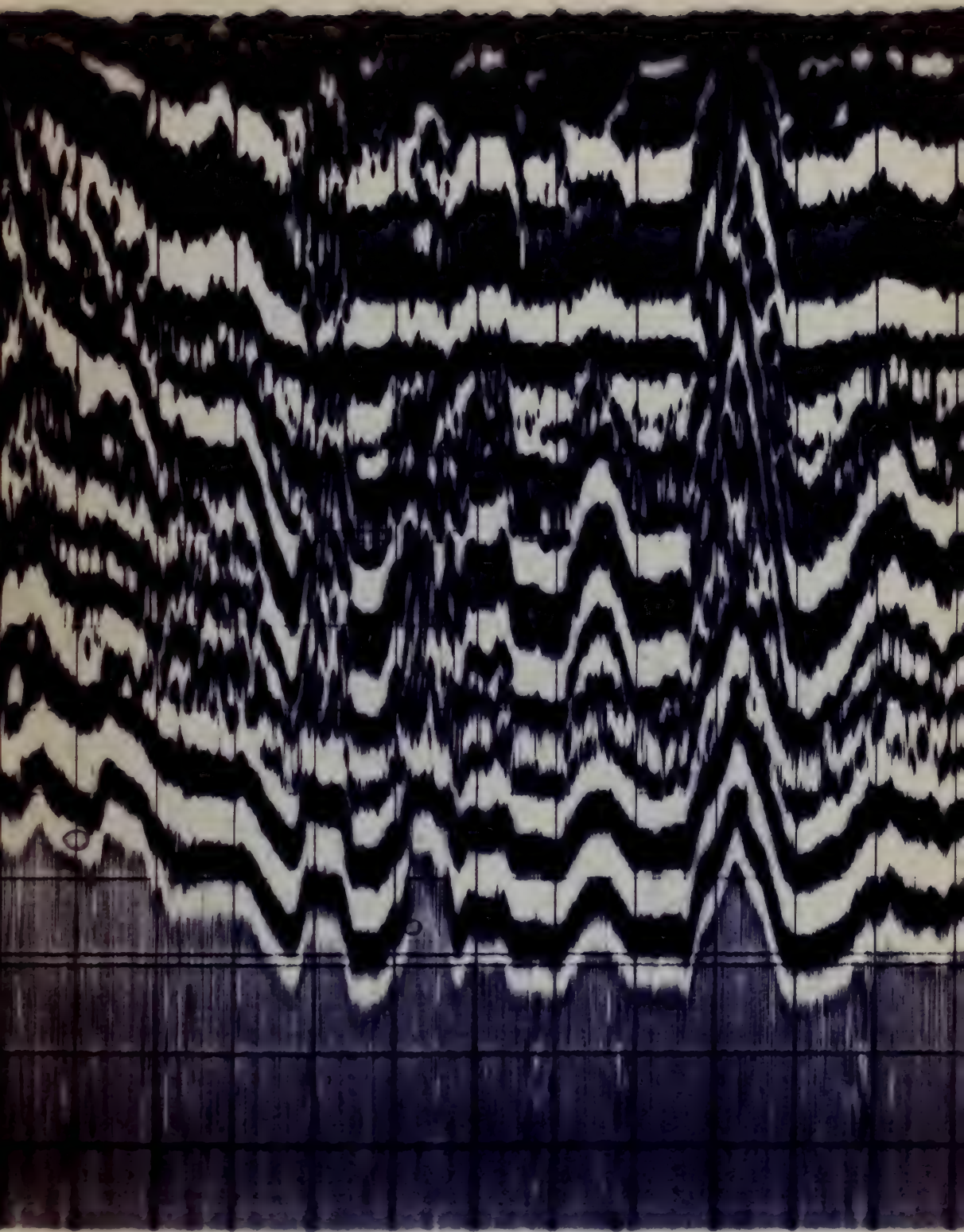
400

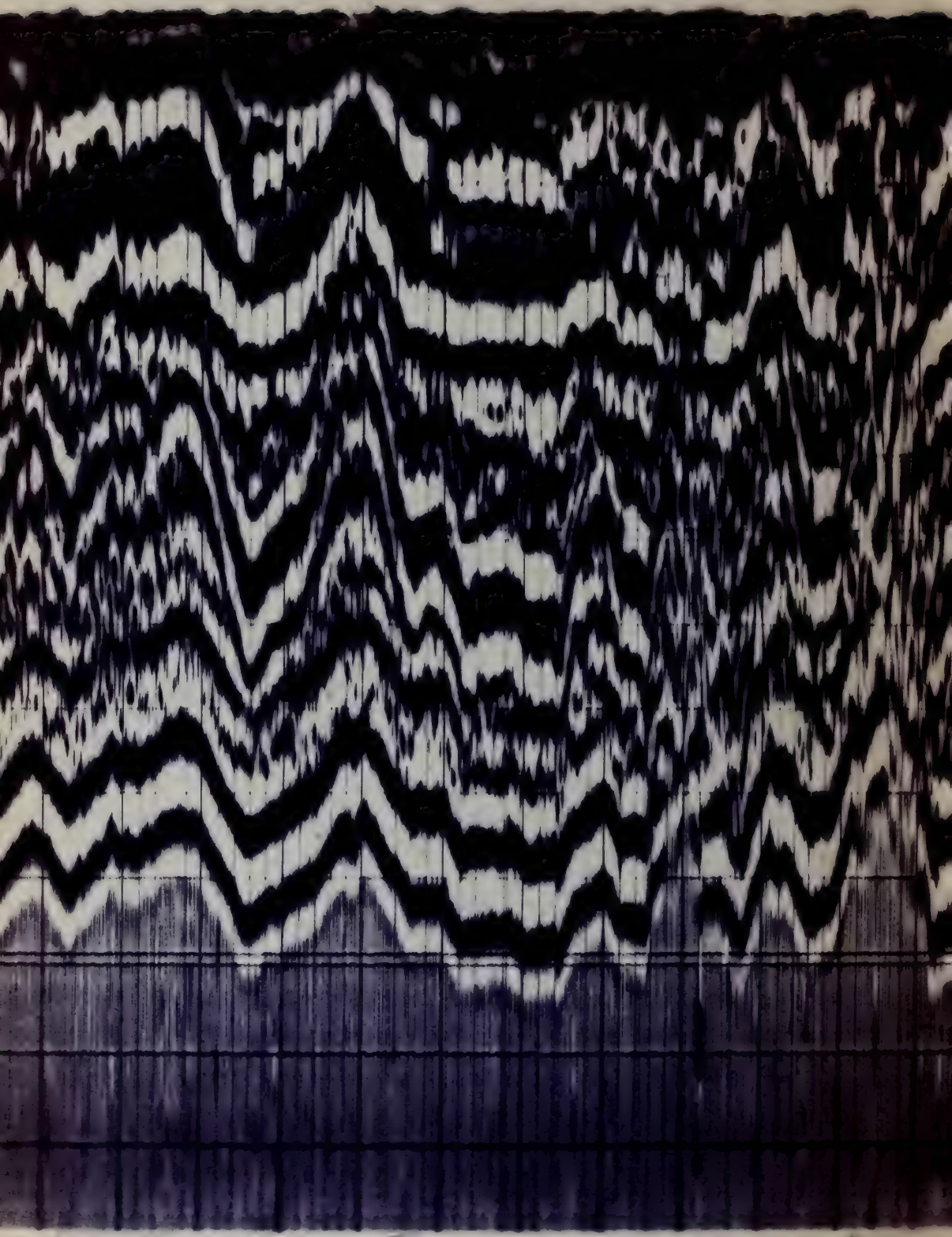


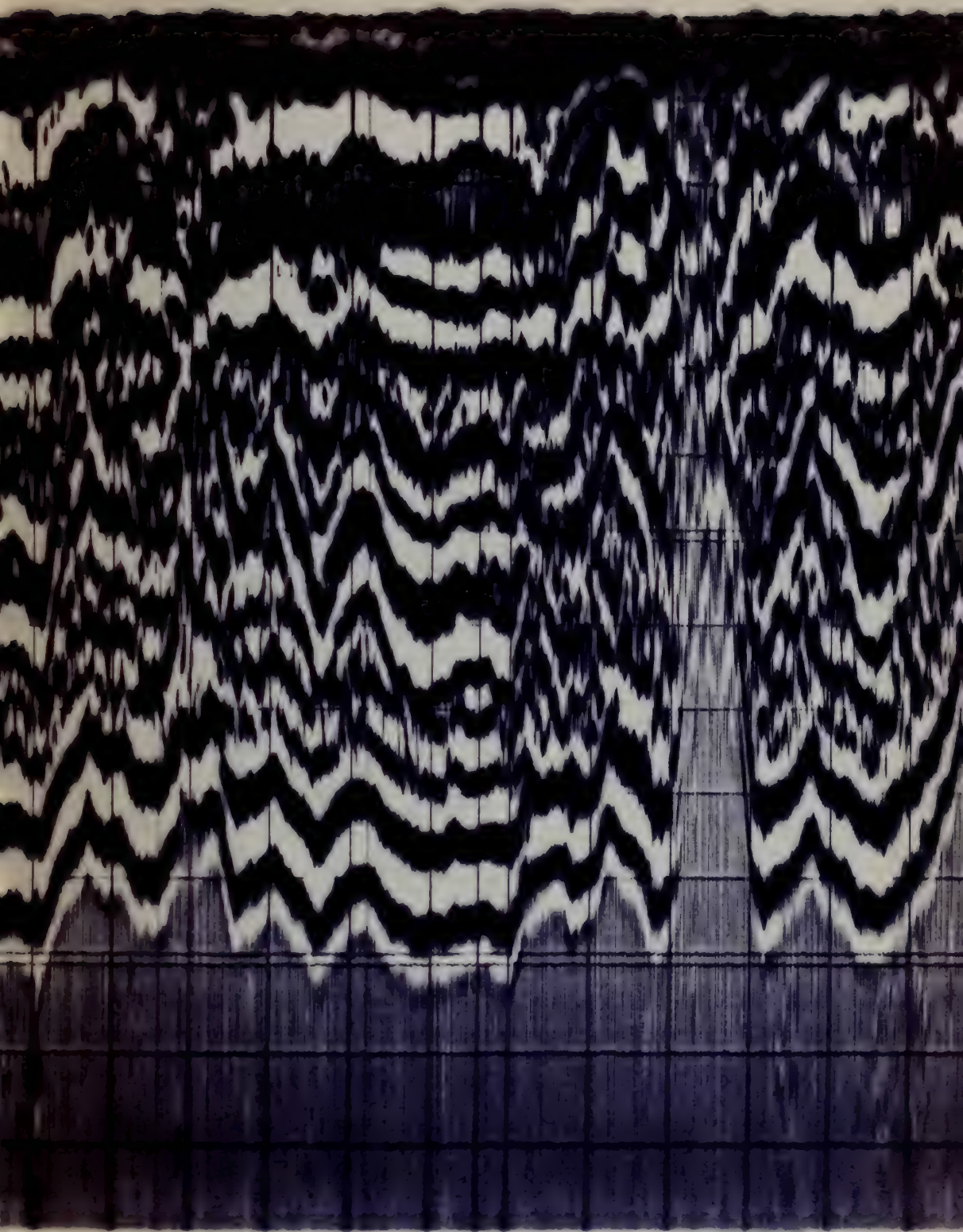


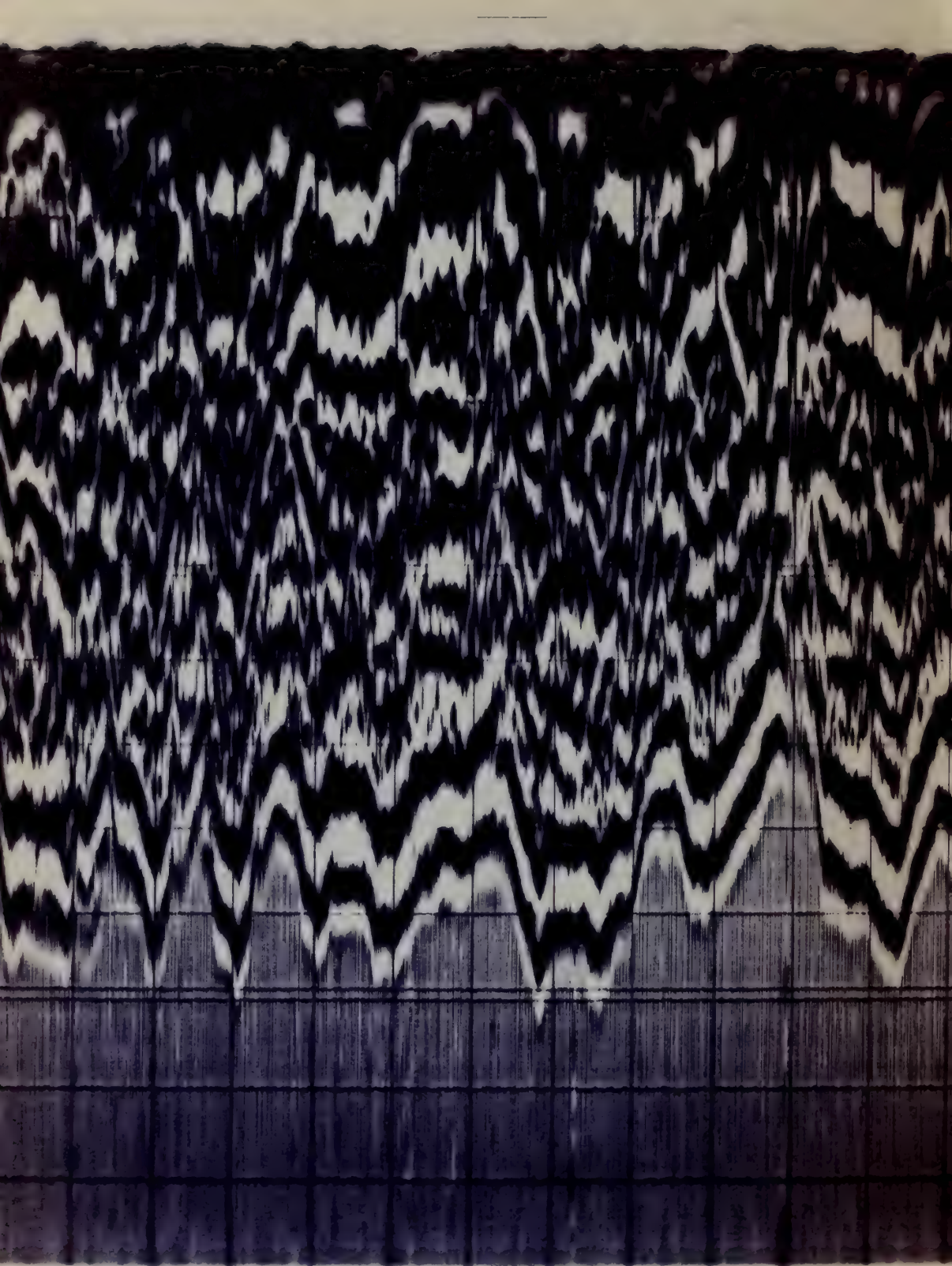


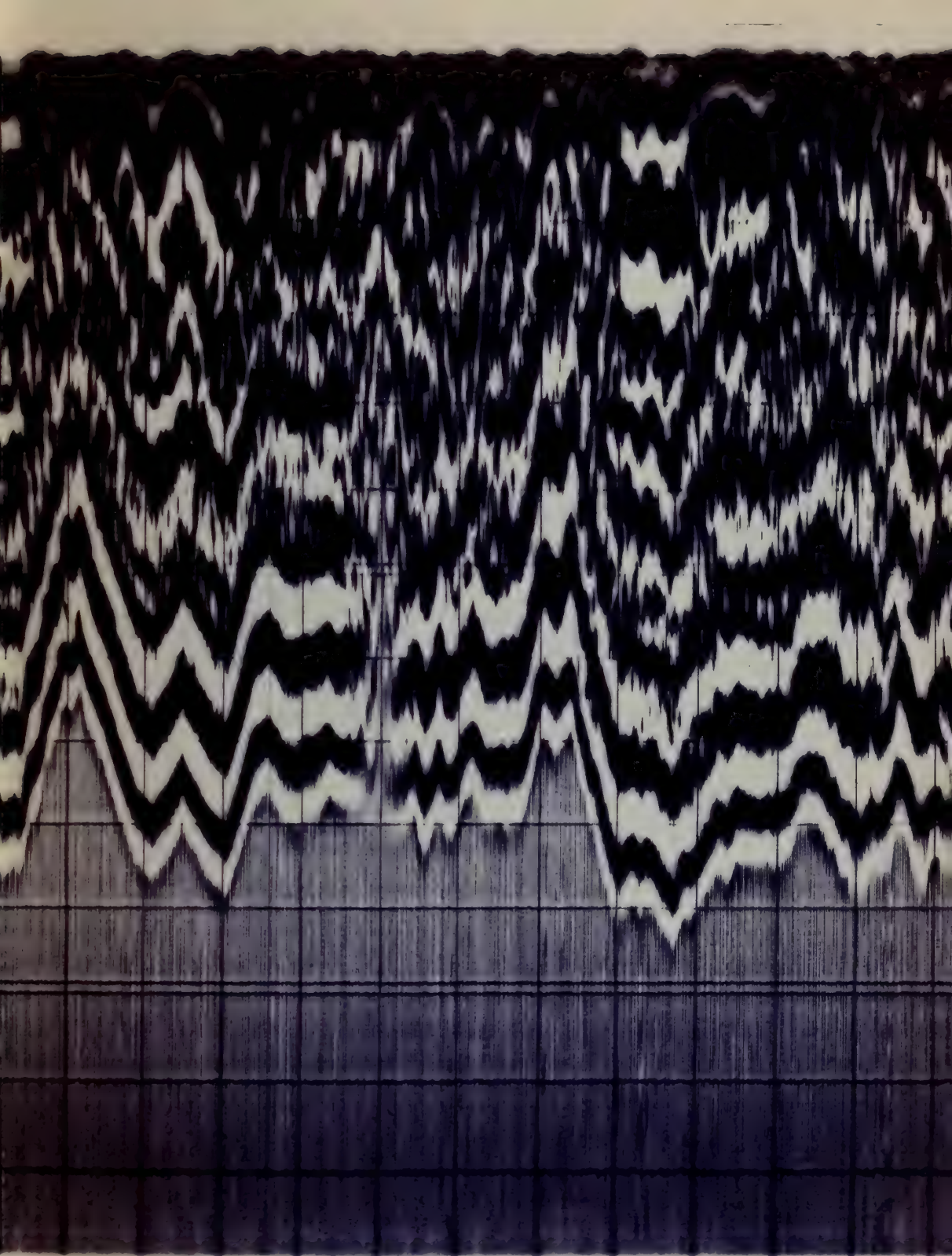


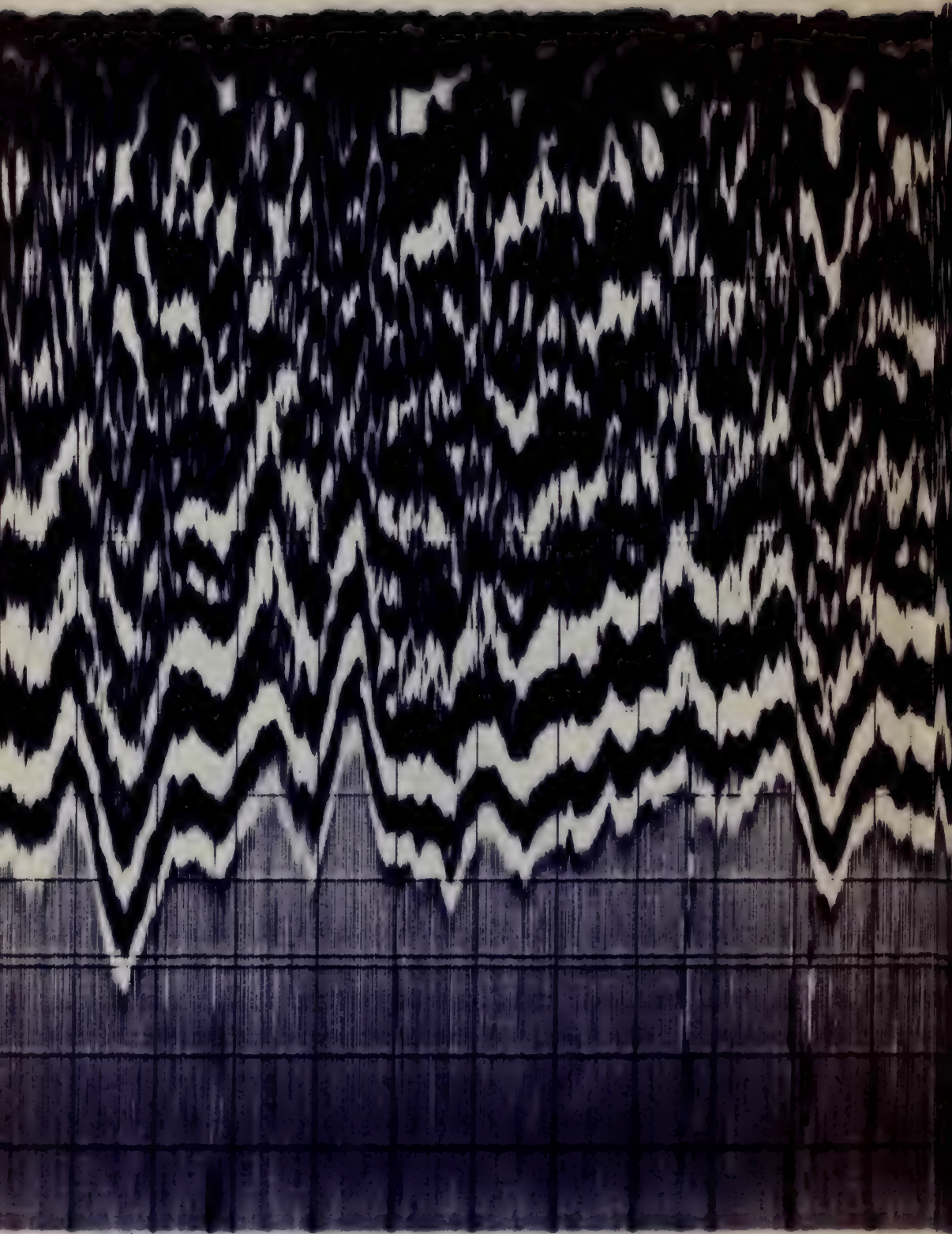












1620'
T.D.
1620'



Birdwell

Electric Log

COMPANY ATLANTIC RICHFIELD COMPANY,

ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD _____

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

OTHER SERVICES:

SEC. 7 TWP. 3S RGE. 96W

CAL V3D FDL
GR/ENP TL

PERMANENT DATUM _____ GROUND LEVEL _____ ELEV. 6909'

LOG MEASURED FROM _____ GL _____ FT. ABOVE PERM. DATUM

DRILLING MEASURED FROM _____ GL _____

ELEV. K.B. _____

D.F. _____

G.L. 6909'

DATE	2 JULY 74				
RUN NO.	1				
DEPTH-DRILLER	1621				
DEPTH-LOGGER	1620				
BTM. LOG INTER.	1618				
TOP LOG INTER.	430				
CASING-DRILLER	7" @ 62'	@	@	@	
CASING-LOGGER	62				
BIT SIZE	6-1/4"				
TYPE FLUID IN HOLE	WATER				
DENS.	VISC.				
pH	FLUID LOSS		ml	ml	ml
SOURCE OF SAMPLE	PIT				
Rm @ MEAS. TEMP.	9 @ 74 °F	@ °F	@ °F	@ °F	@ °F
Rmf @ MEAS. TEMP.	@ °F	@ °F	@ °F	@ °F	@ °F
Rmc @ MEAS. TEMP.	@ °F	@ °F	@ °F	@ °F	@ °F
SOURCE Rmf Rmc					
Rm @ B. H. T.	@ 78 °F	@ °F	@ °F	@ °F	@ °F
TIME SINCE CIRC.	11 HRS.				
MAX. REC. TEMP.	78 °F	°F	°F	°F	°F
EQUIP. LOCATION	2694	LAS VEGAS			
RECORDED BY	WILSON				
WITNESSED BY	TAIT				

REMARKS NA-NOT AVAILABLE

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES				SCALE CHANGES			
DATE	SAMPLE NO.			TYPE LOG	DEPTH	SCALE UP HOLE	SCALE DOWN HOLE
DEPTH — DRILLER							
TYPE FLUID IN HOLE							
DENS.	VIS.						
pH	FLUID LOSS		ml				
SOURCE OF SAMPLE				EQUIPMENT DATA			
R _m @ MEAS. TEMP.	@	OF	@	RUN NO.	TOOL TYPE	PAD TYPE	TOOL POSITION
R _{mf} @ MEAS. TEMP.	@	OF	@	ONE	E LOG		FREE
R _{mc} @ MEAS. TEMP.	@	OF	@				
SOURCE R _{mf} R _{mc}							
R _m @ B. H. T.	@	OF	@				
R _{mf} @ B. H. T.	@	OF	@				
R _{mc} @ B. H. T.	@	OF	@				

SPONTANEOUS-POTENTIAL MILLIVOLTS	DEPTHS	RESISTIVITY OHMS M ² /M	RESISTIVITY OHMS M ² /M
- 125 +		0 16" NORMAL 5000	18' 8" LATERAL 500
		0 5000	5000
		0 64" NORMAL 500	

CALIBRATION DATA

AFTER LOG

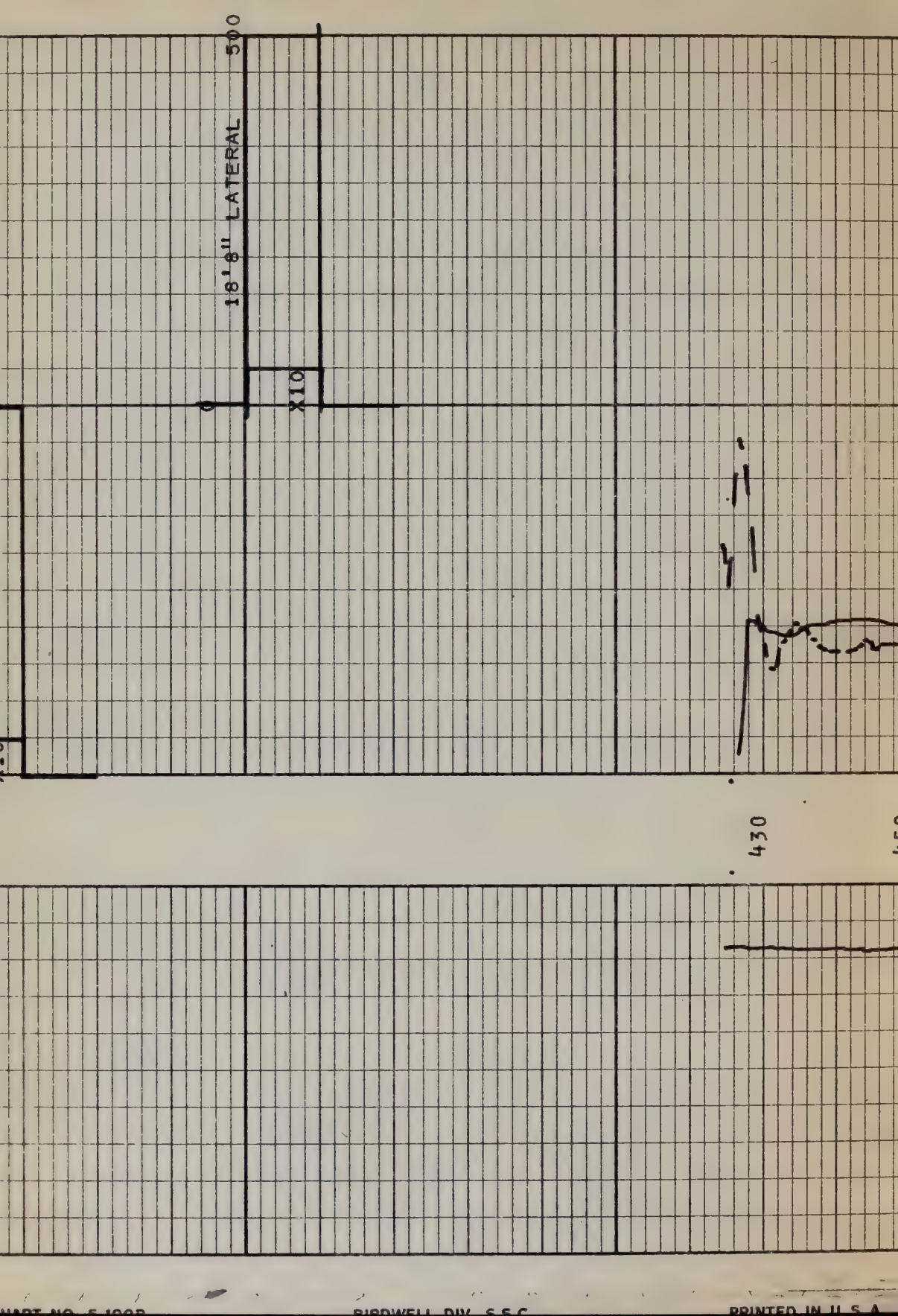
SP

100 MV

16" NORMAL 500

X10

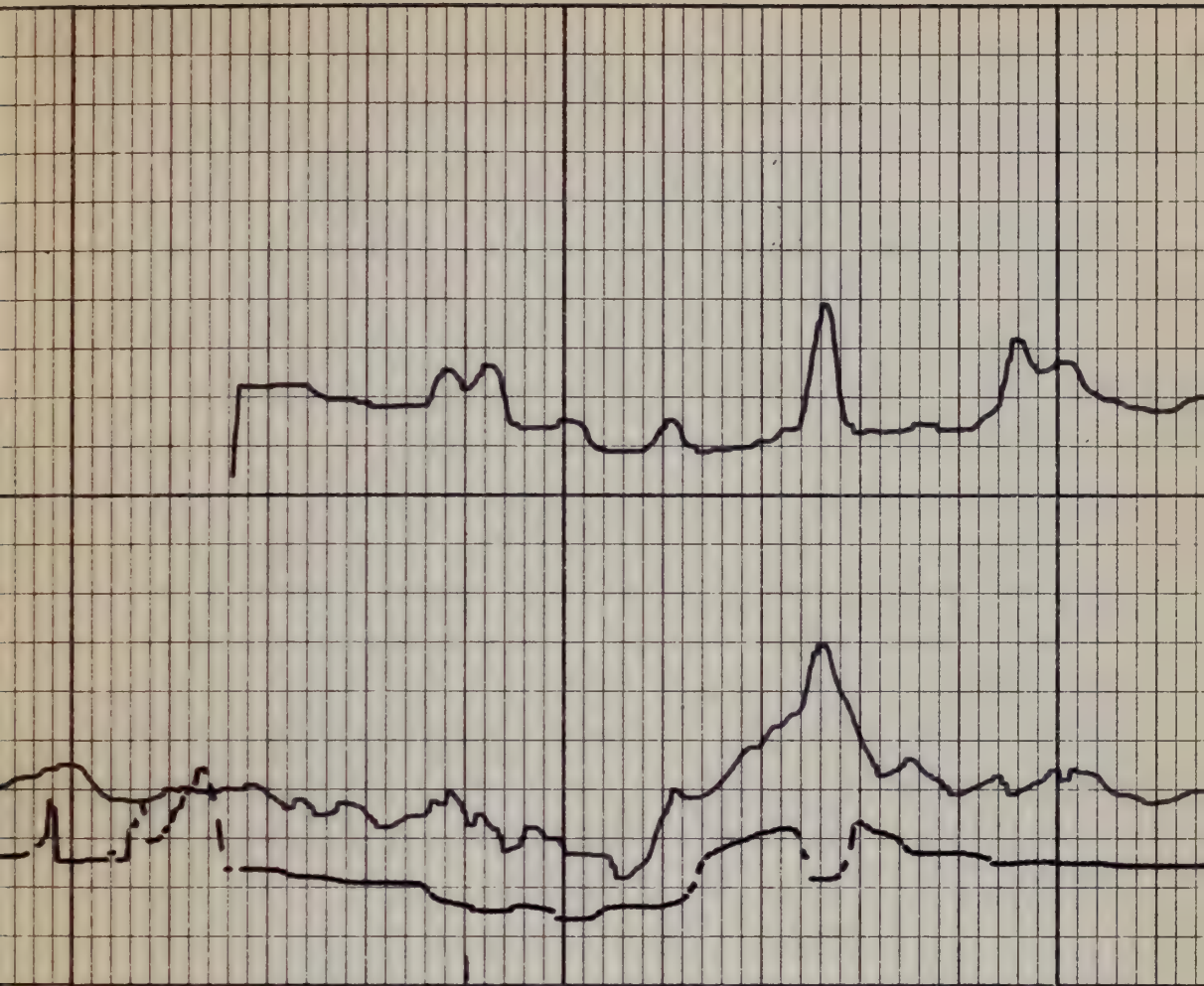
64" NORMAL 500



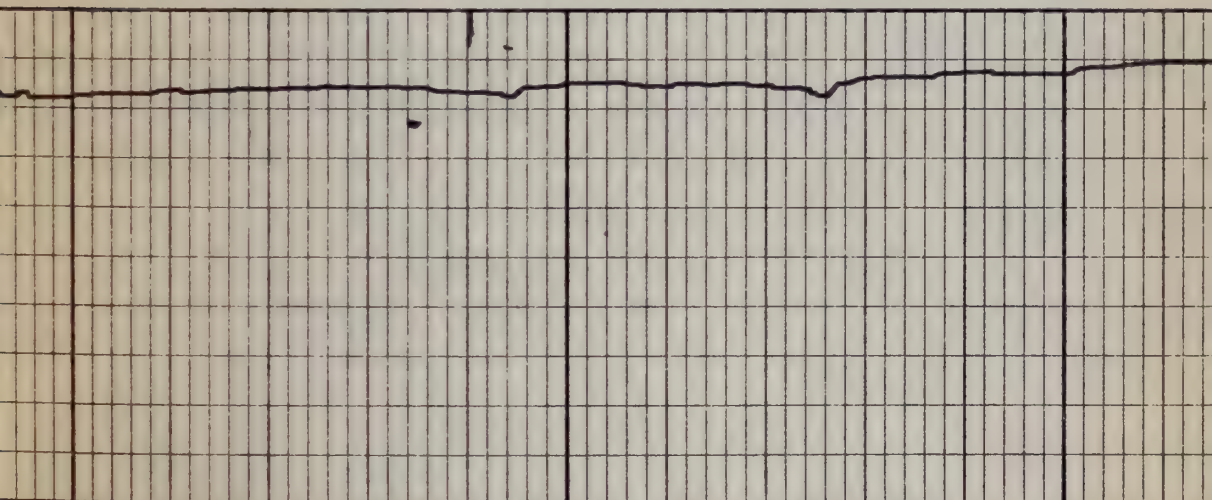
16' 8" LATERAL 500

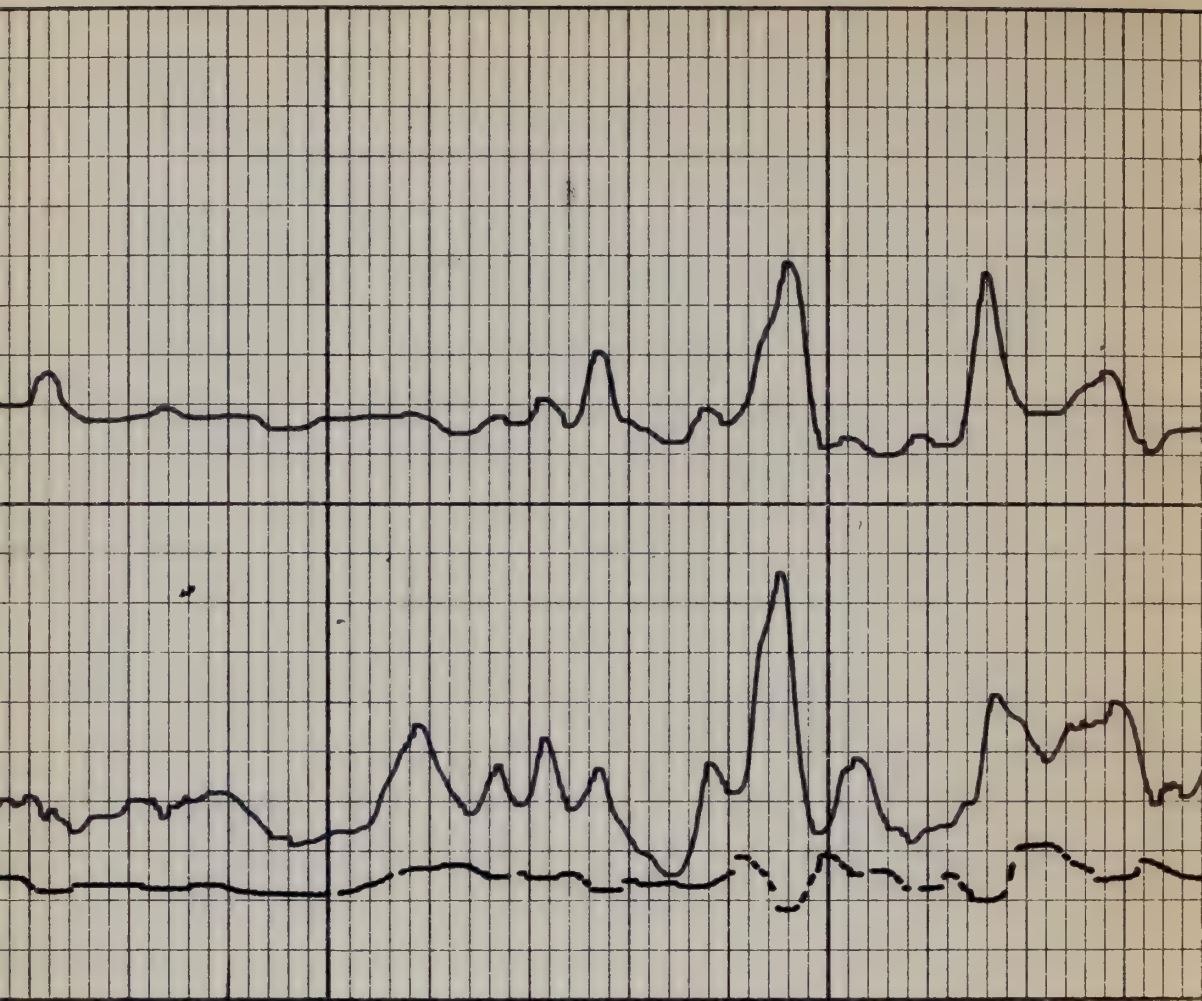
X10

430

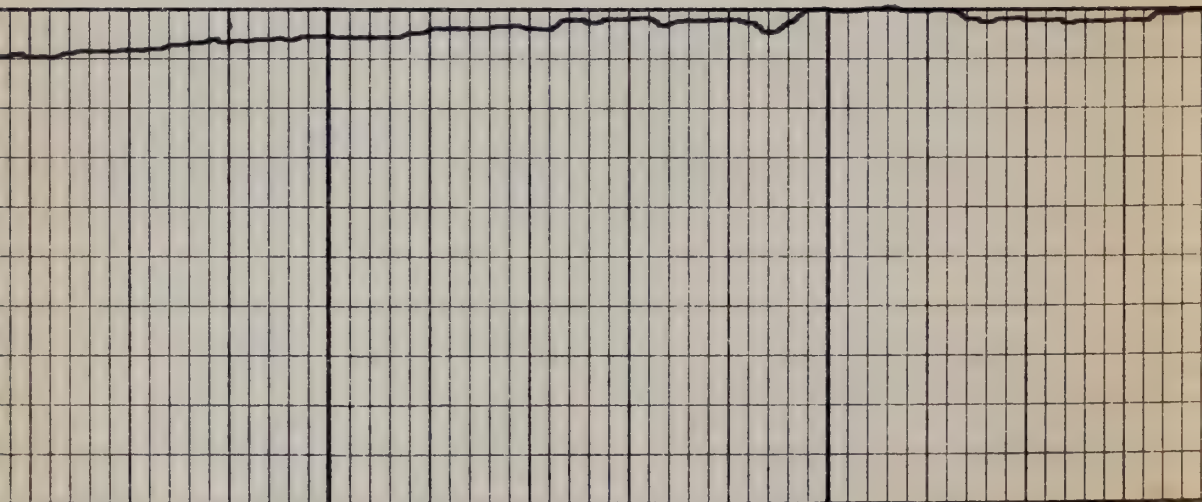


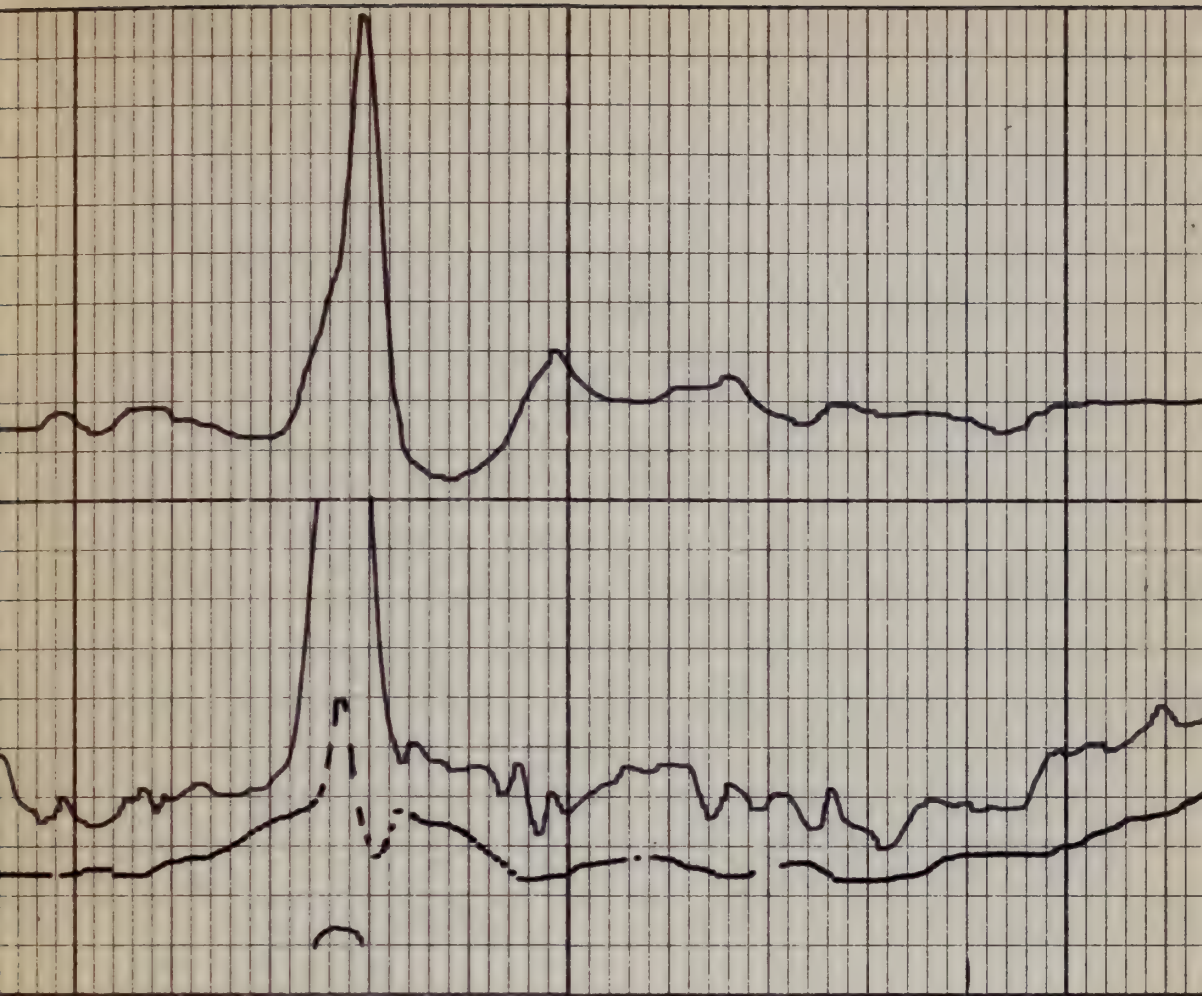
500



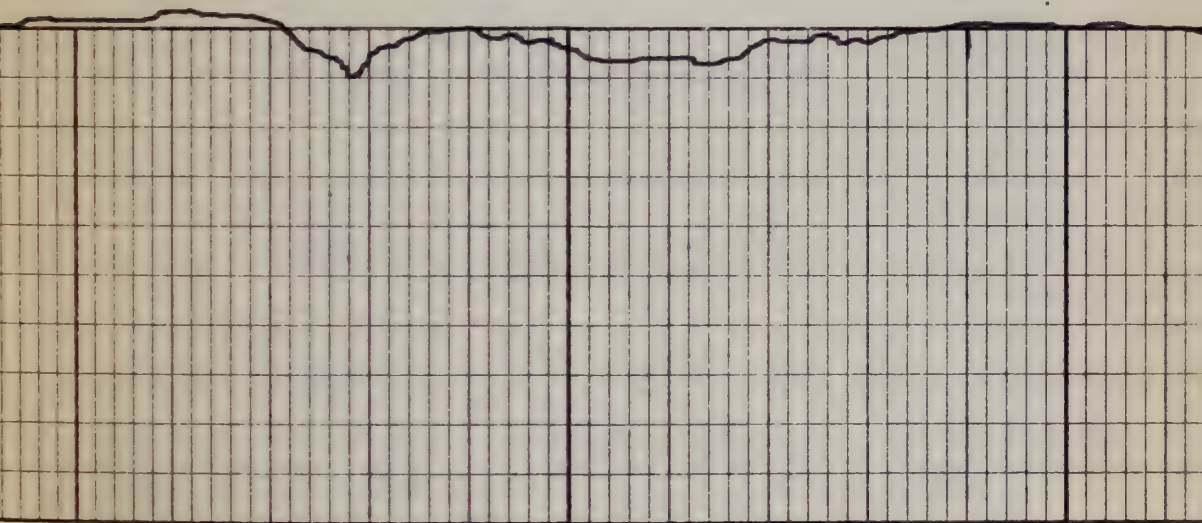


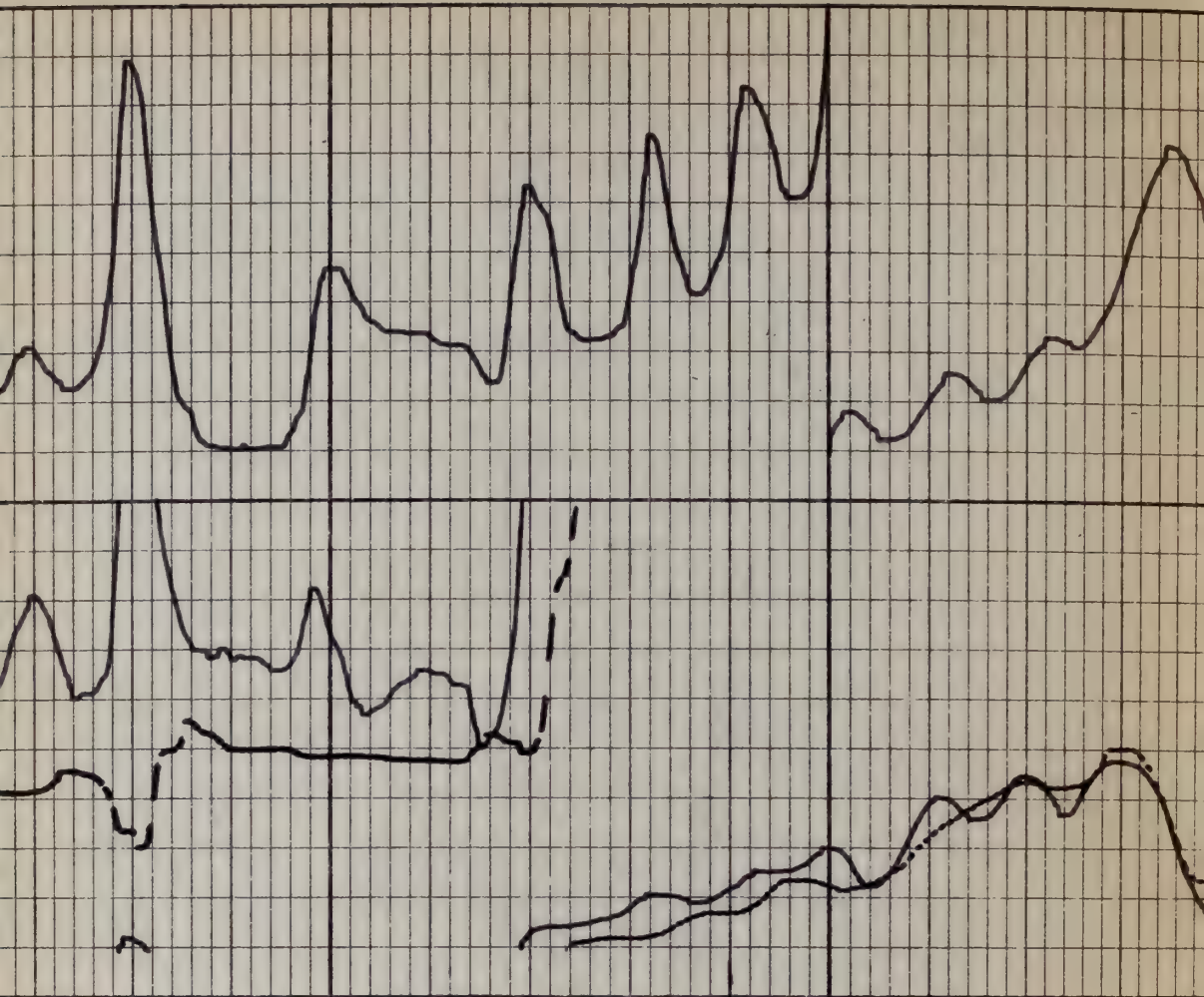
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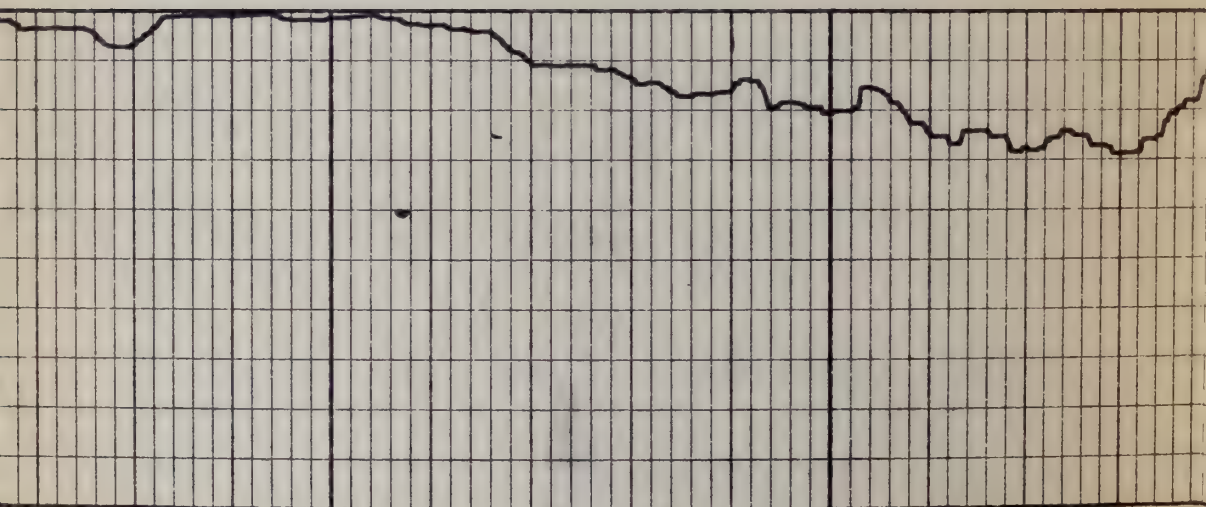


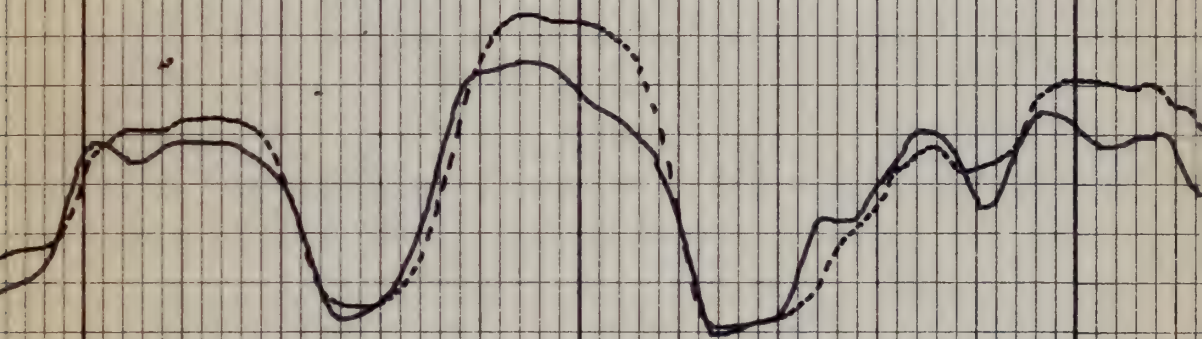
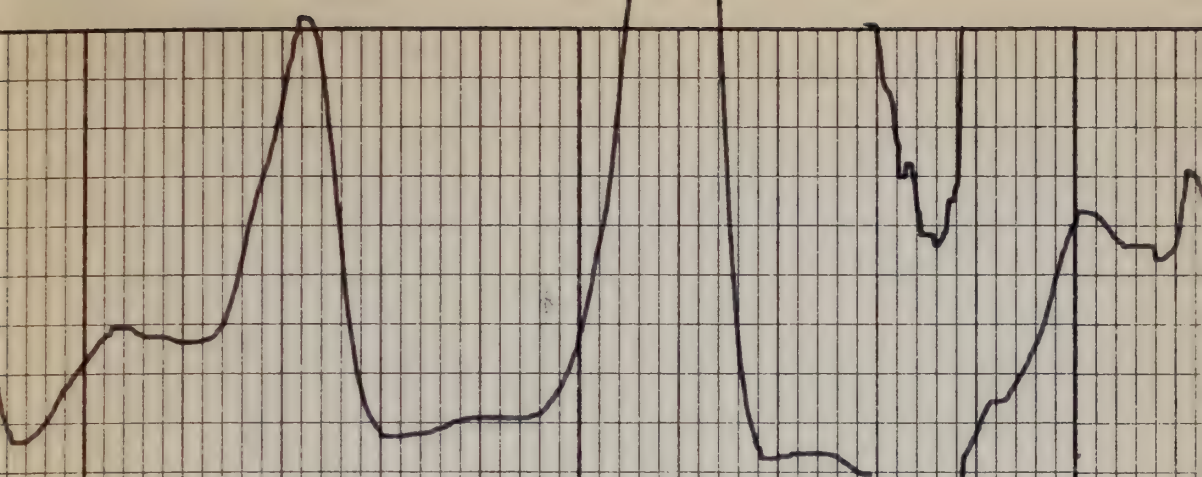
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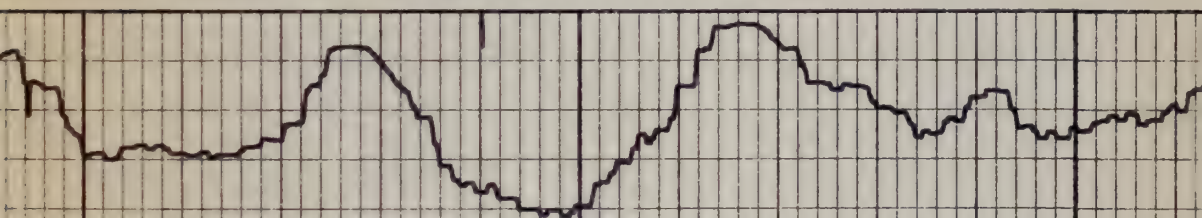


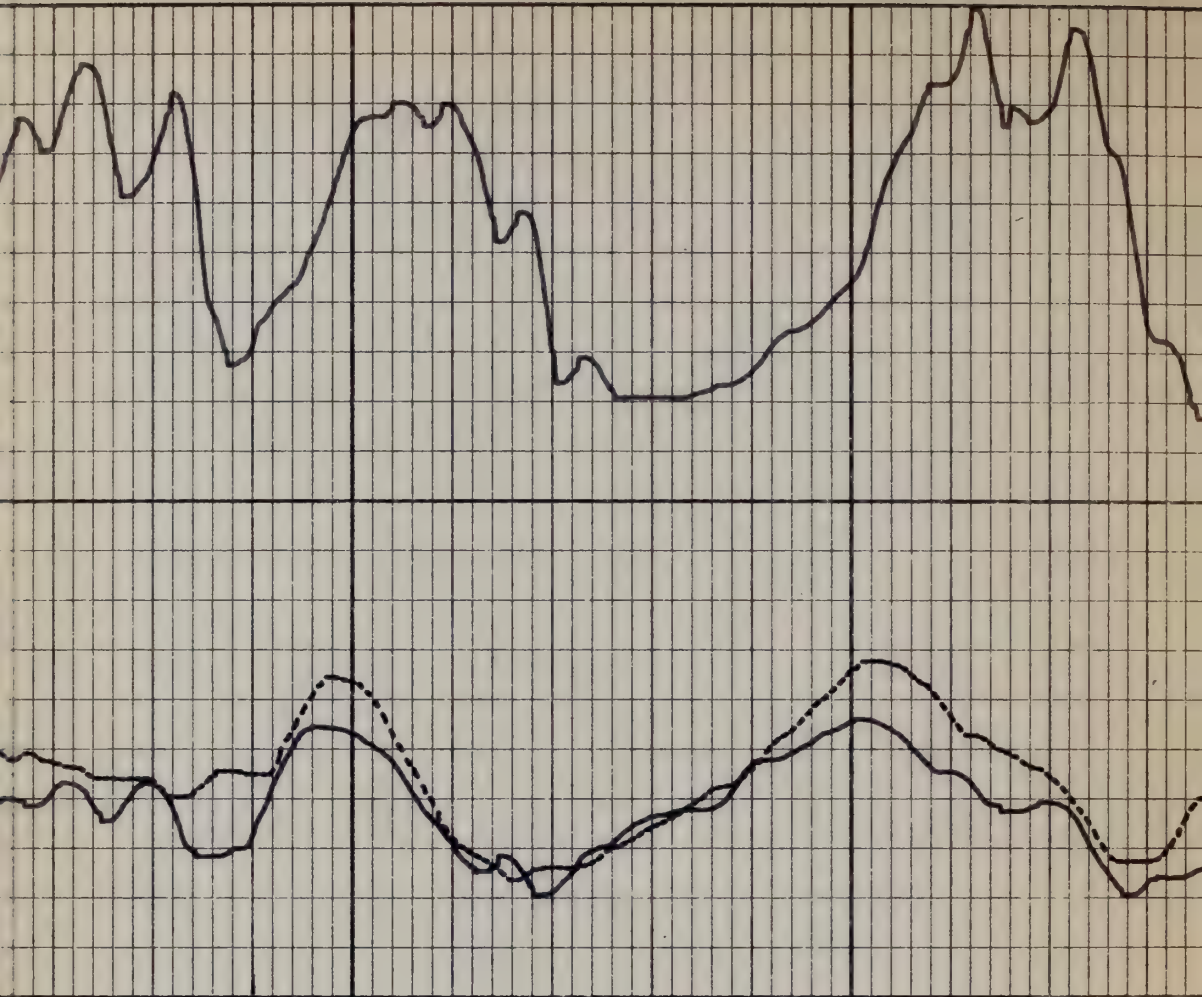
900



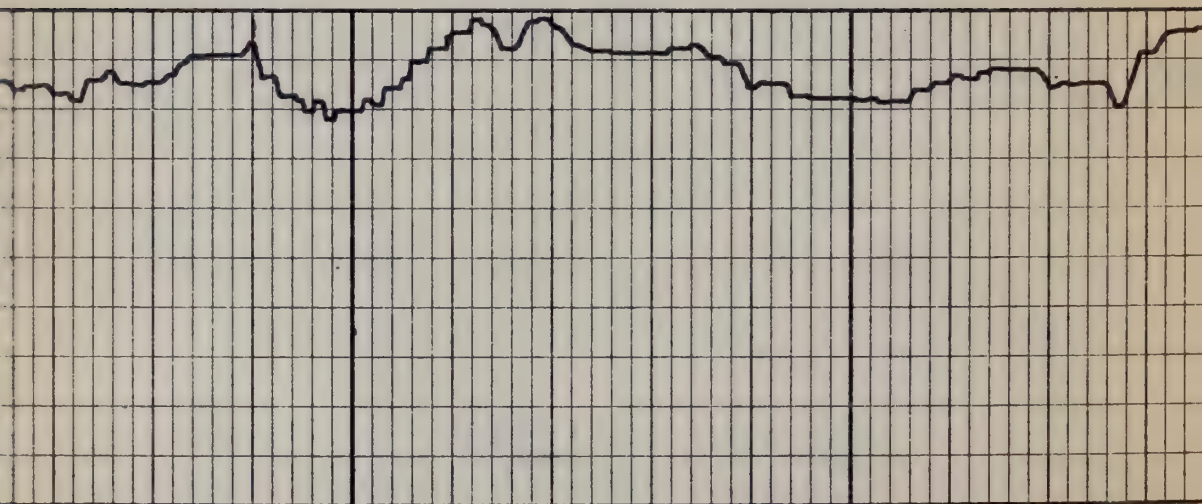


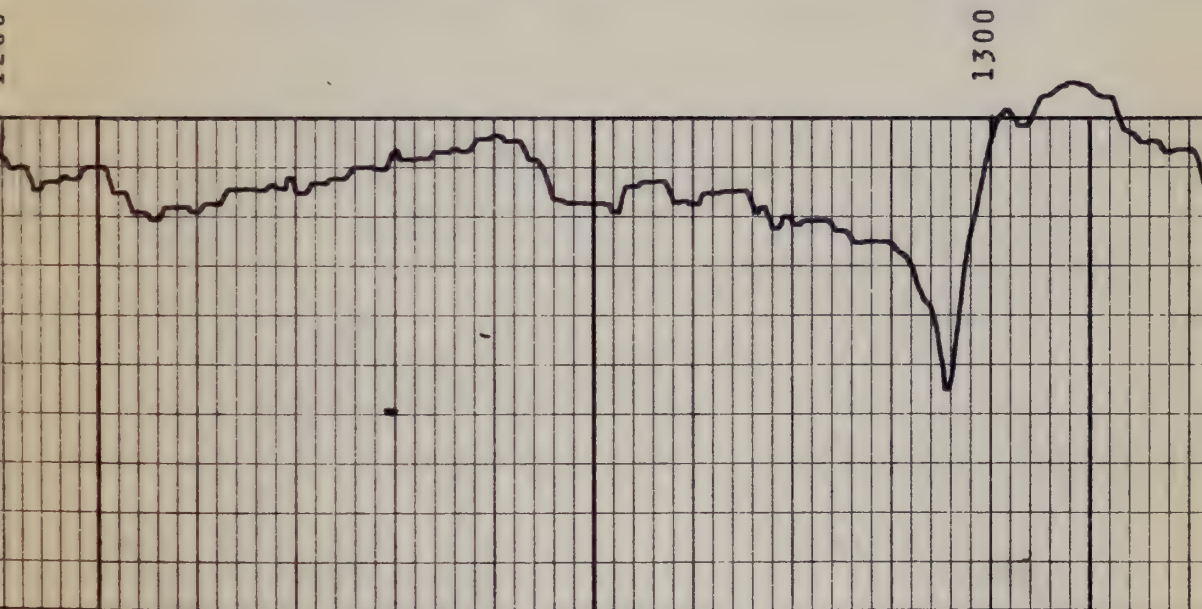
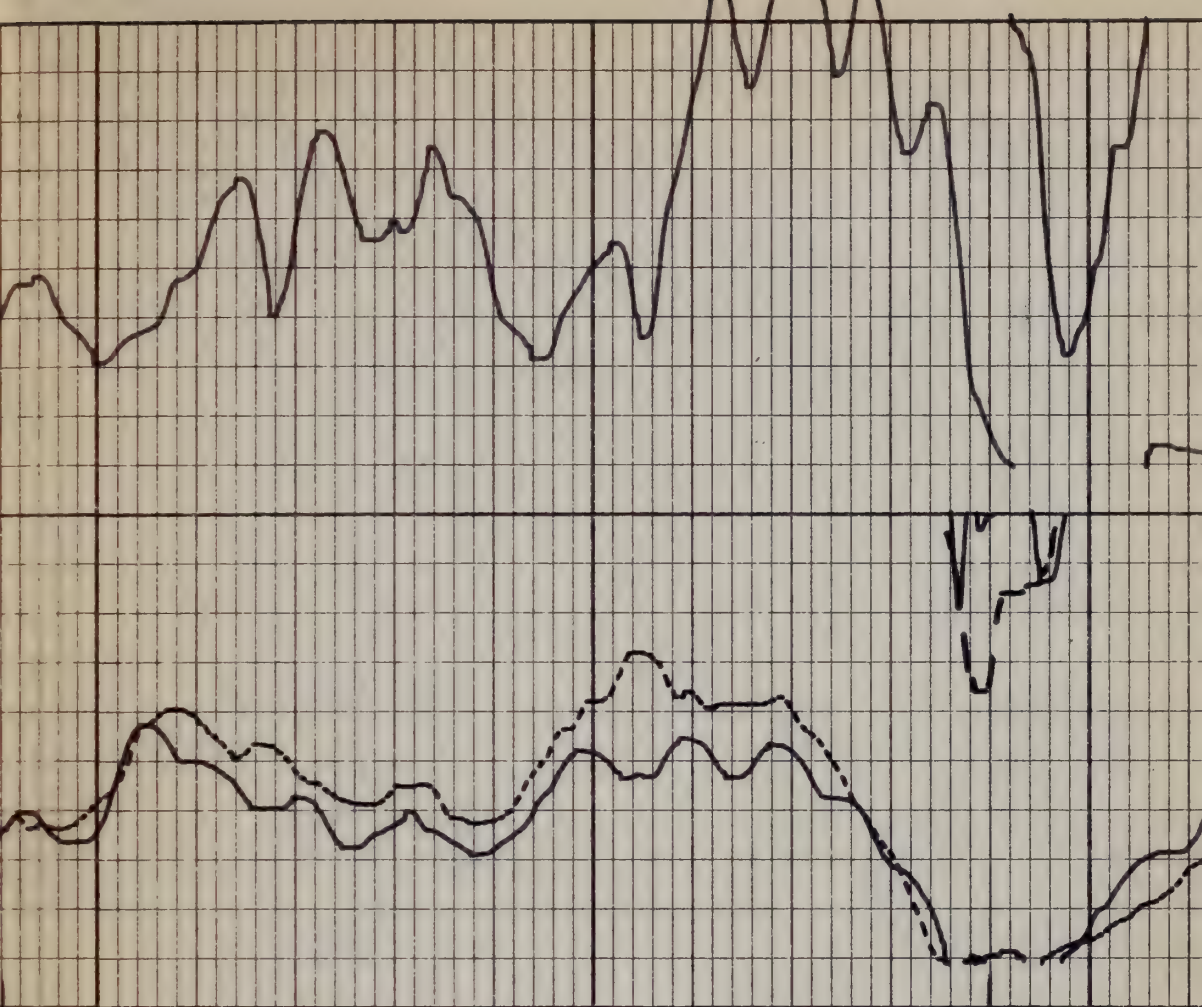
1000

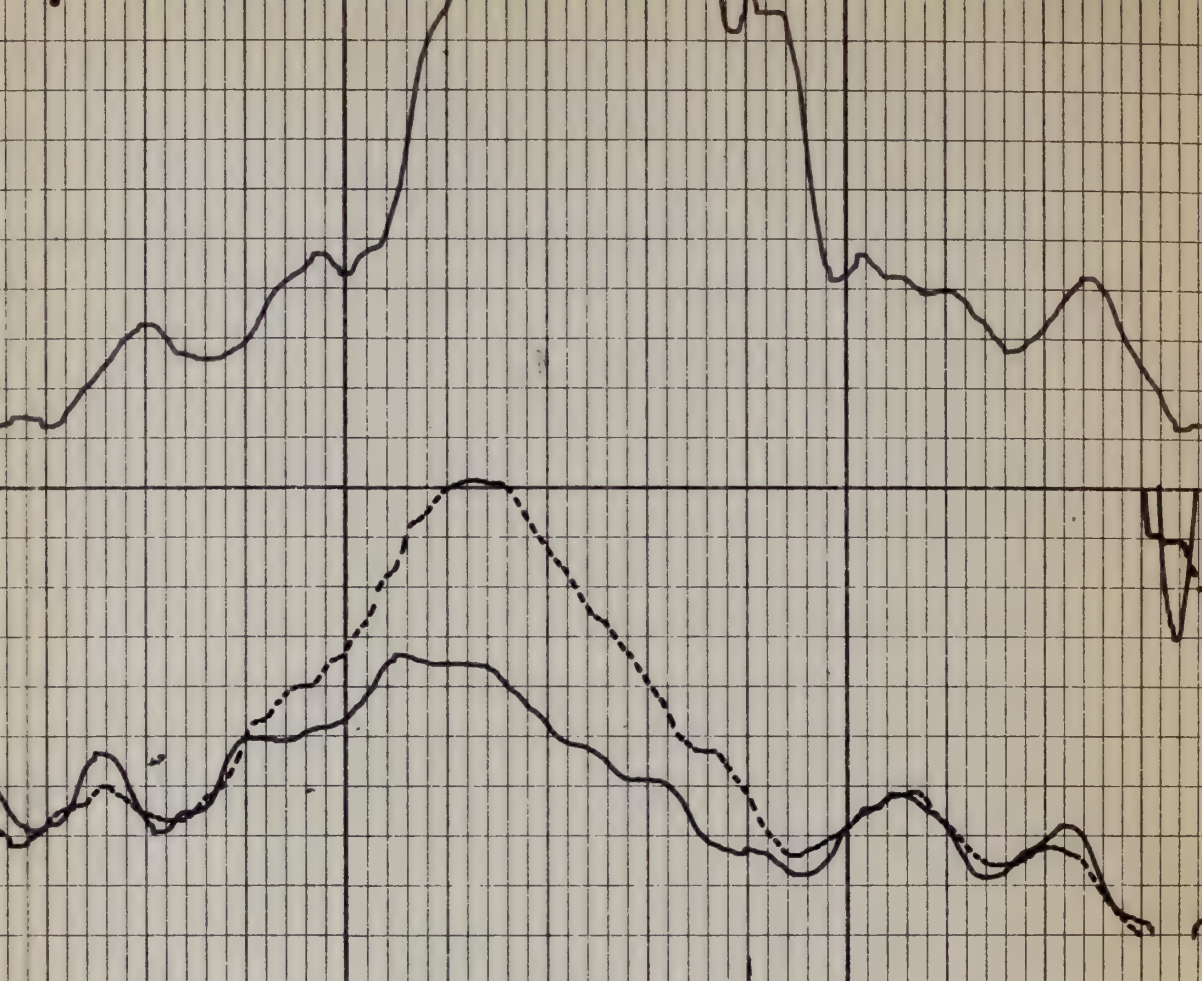




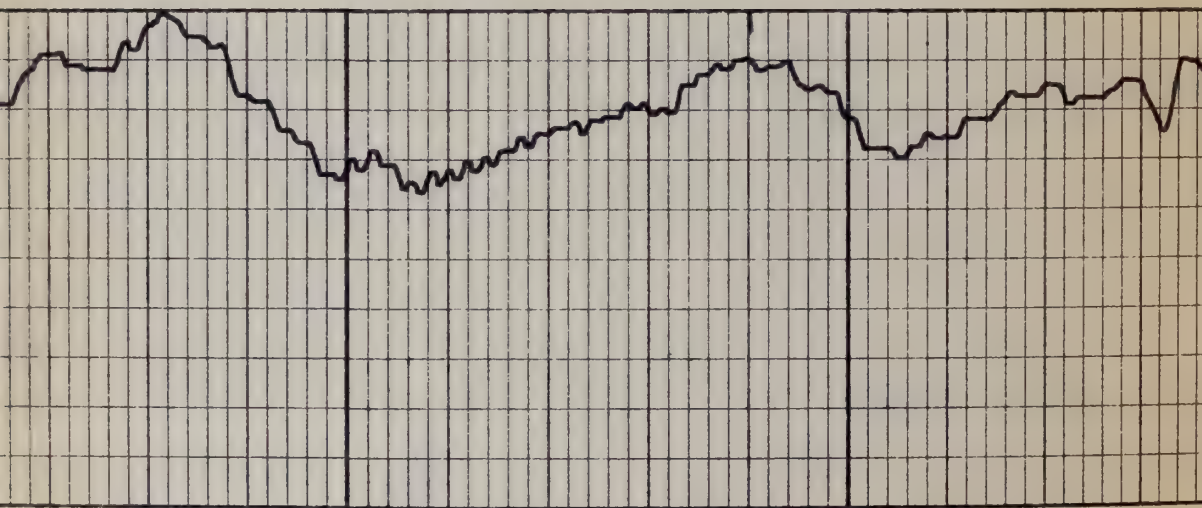
1100





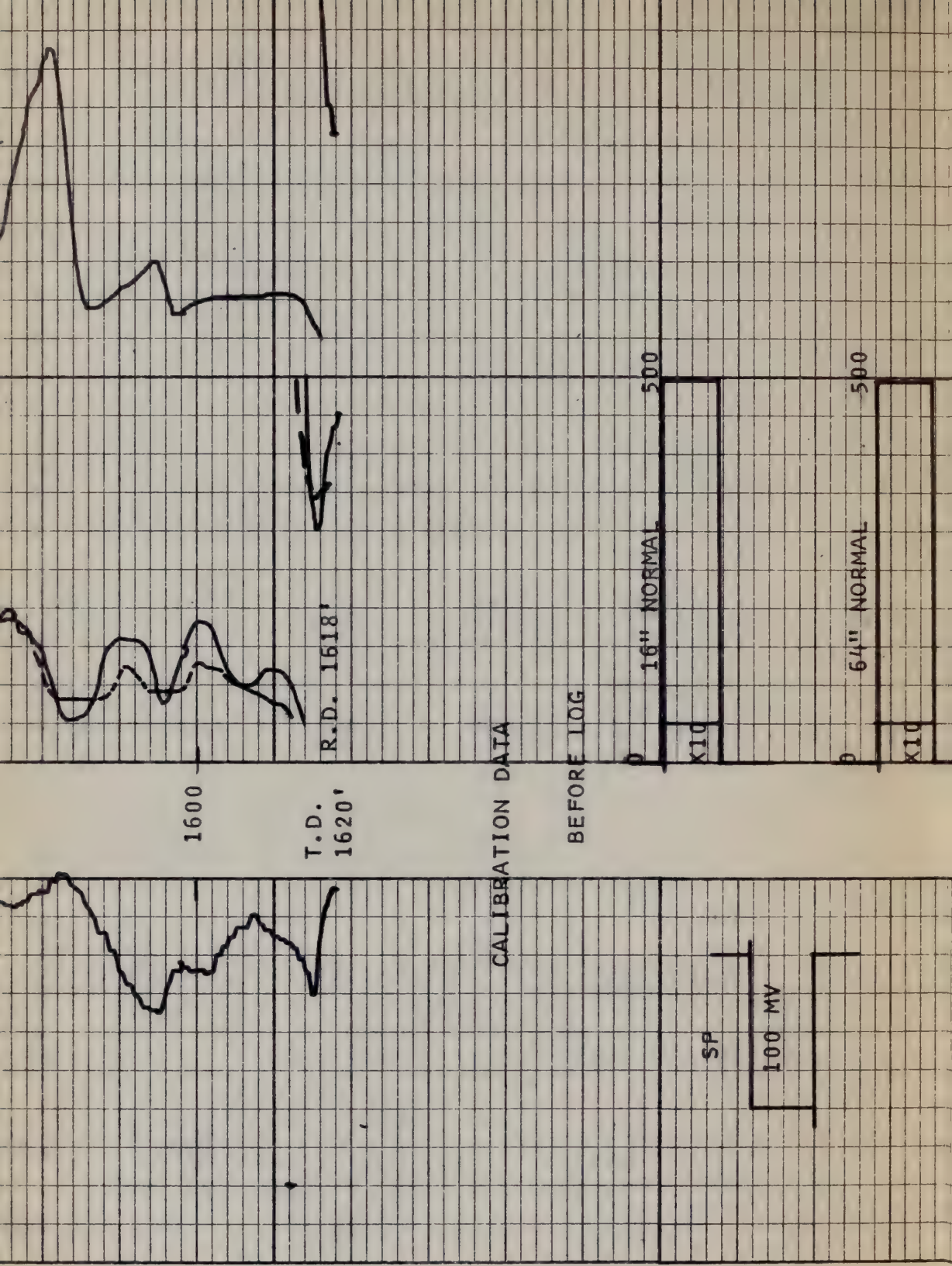


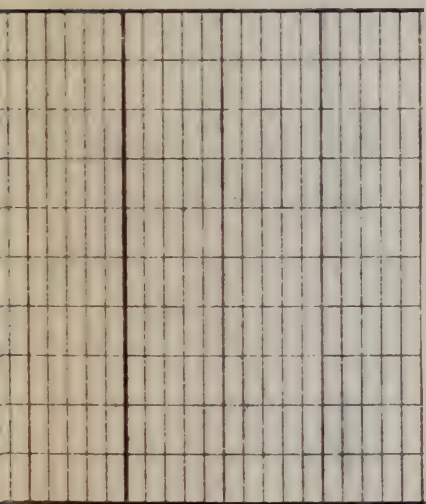
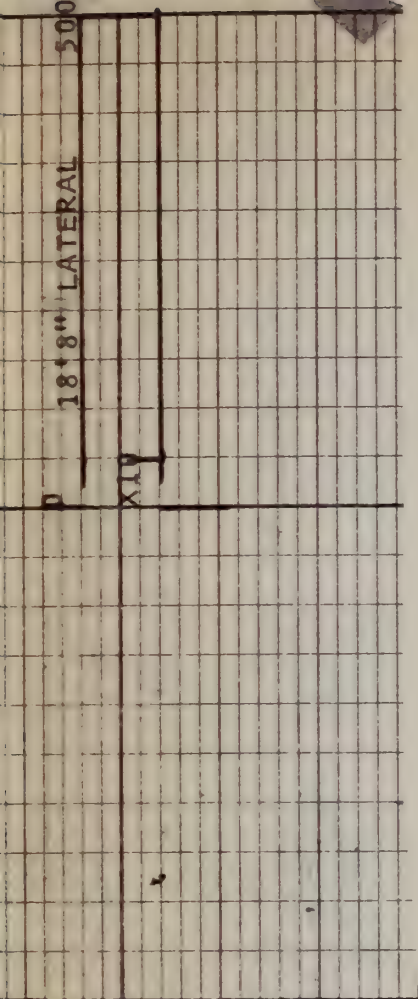
1400





1500







Birdwell

Density Log

COMPANY ATLANTIC RICHEFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #A-1

FIELD _____

COUNTY RIO BLANCO **STATE** COLORADO

LOCATION:

OTHER SERVICES
V3D CAL TL
GR/ENP ES

SEC. 7 **TWP.** 3S **RGE.** 96W

ELEVATIONS:

PERMANENT DATUM GROUND LEVEL, **ELEV.** 6909'
LOG MEASURED FROM GL, _____ **ft. above perm. datum**
DRILLING MEASURED FROM GL

KB. _____
DF. _____
GL. 6909'

DATE	2 JULY 74	
RUN NO.	1	
TYPE LOG	FDL	
DEPTH - DRILLER	1621	
DEPTH - LOGGER	1620	
BOTTOM LOGGED INTERVAL	1618	
TOP LOGGED INTERVAL	50	
TYPE FLUID IN HOLE	WATER	
SALINITY PPM CL.		
DENSITY LB./GAL.		
LEVEL	412	
MAX. REC. TEMP. - DEG. F	78°	
OPERATING RIG TIME	1 HR.	
RECORDED BY	WILSON	
WITNESSED BY	TAIT	
LOCATION	LAS VEGAS	

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	5-1/4"	62'	1621'	7"		0	62'

GAMMA-GAMMA EQUIPMENT DATA

RUN NO.	1	TOOL SPACING	19"
TOOL MODEL NO.	LAHD	SOURCE NO.	V-476
TOOL SERIAL NO.	W-11	DIRECT ZERO LOC.	
DIAMETER	3 5/8"	DISTANCE D OR D'	13"
SUB	PB	NOMINAL HOLE DIAM.	6-1 1/4"
DETECT. MODEL NO.	9371 TN	TRUCK NO.	2694

GAMMA-GAMMA LOGGING DATA

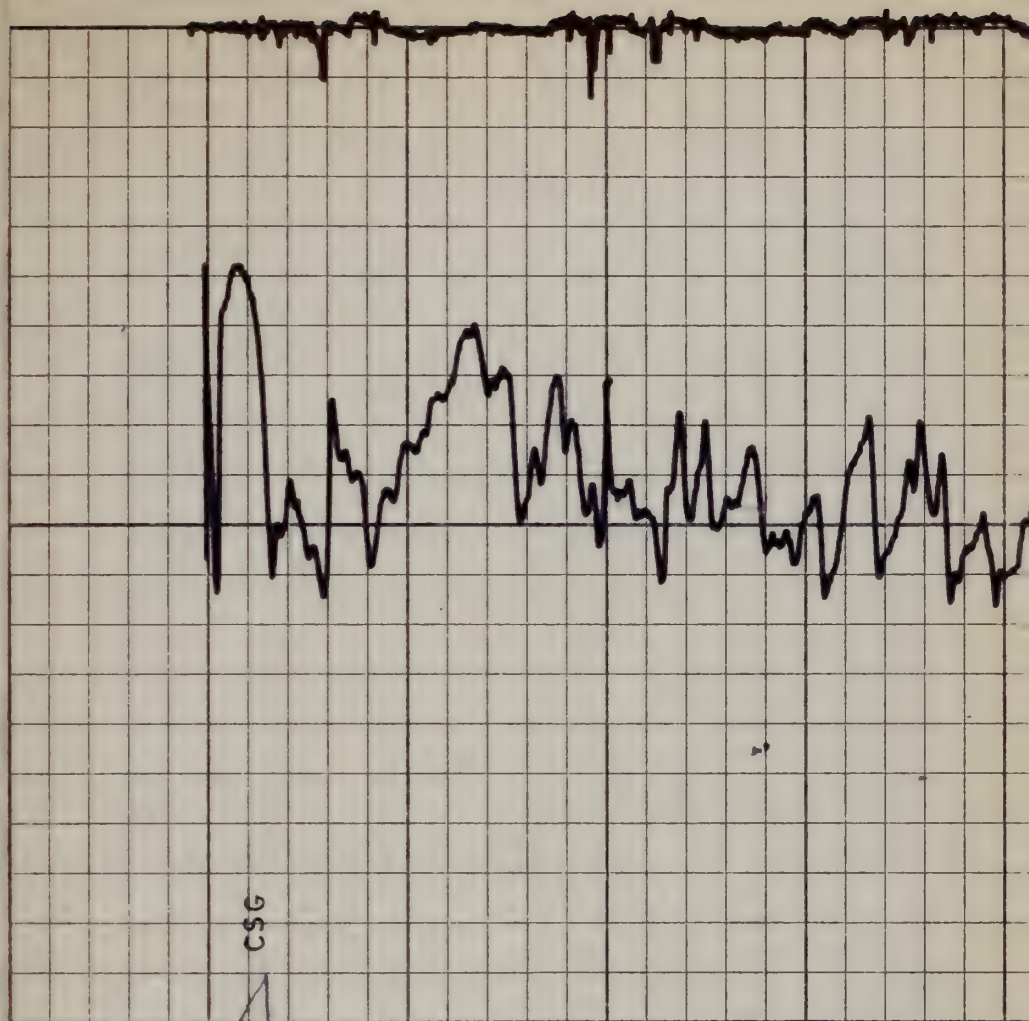
RUN NO.	DEPTHS	SPEED	TC	DIRECT	LINEAR	PRIMARY REFERENCE	PRIMARY REFERENCE
	FROM TO	FT./MIN.	SEC.	CPM /DIV.	GMS./DIV.	EQUIVALENT DEN. G/CC	EQUIVALENT DEN. G/CC
1	1618'	20	3	10X10 ⁴	.05	SECONDARY REF.	2.605
						EQUIVALENT DEN. G/CC	1.747
						KCPM BEFORE LOG	
						KCPM AFTER LOG	
						REORDER CAL. REF.	25K
						EQUIVALENT DEN. G/CC	2.36
						GRAIN DENSITY GMS/CC:	50K
						FLUID DENSITY GMS/CC:	2.07

REMARKS: THIS WORK WAS PERFORMED UNDER UNITED STATES ATOMIC ENERGY COMMISSION BY-PRODUCT MATERIAL LICENSE NO. 35-5651-1

NA: INFORMATION NOT AVAILABLE

NOTE: RECORDED BULK DENSITY MUST BE CORRECTED FOR STANDOFF (PROXIMITY INDEX)

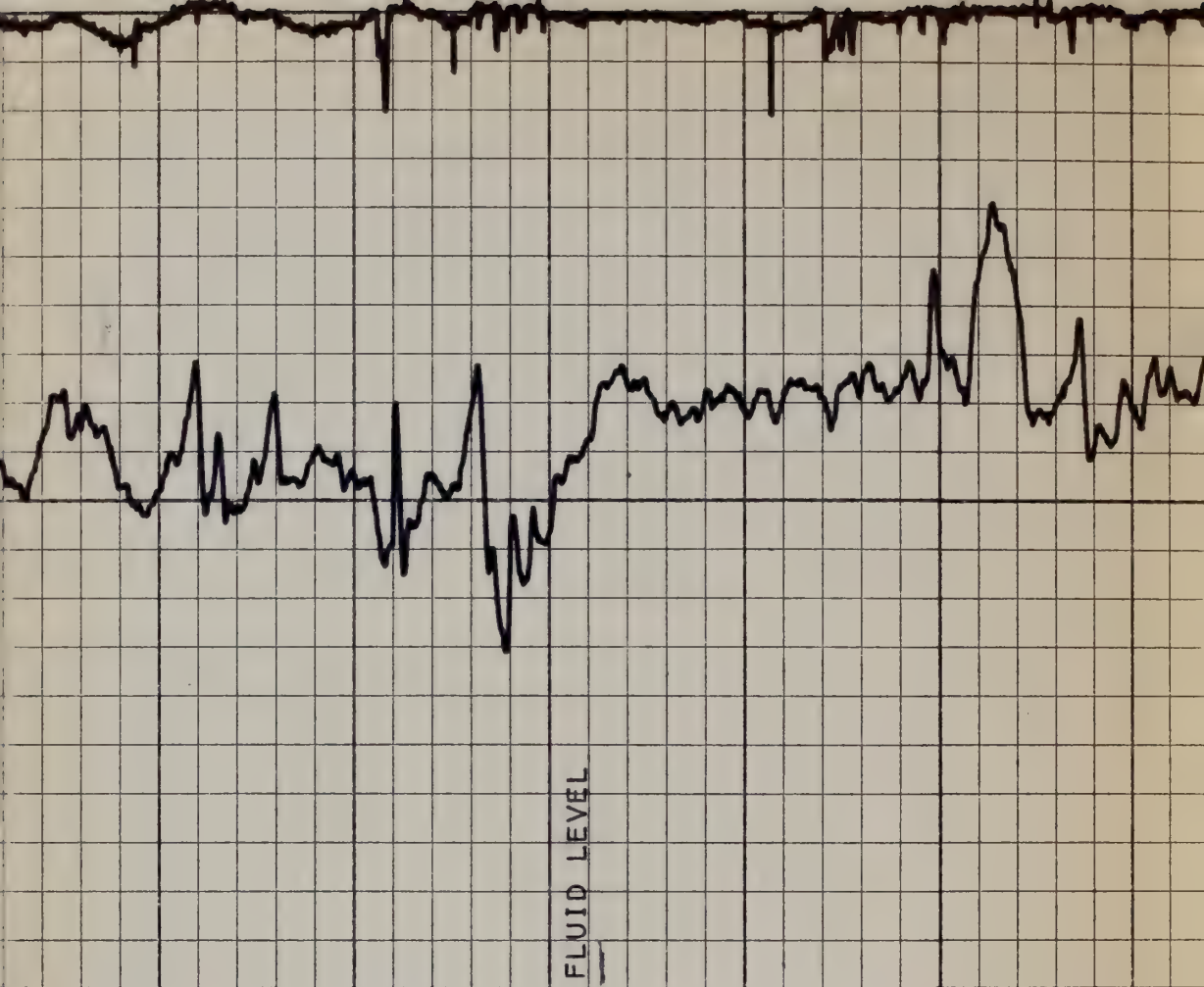
DEPTH	BULK DENSITY GRAMS/CC	PROXIMITY INDEX INCHES
1.6	2.1	2 6
DIRECT COUNT RATE KCPM		

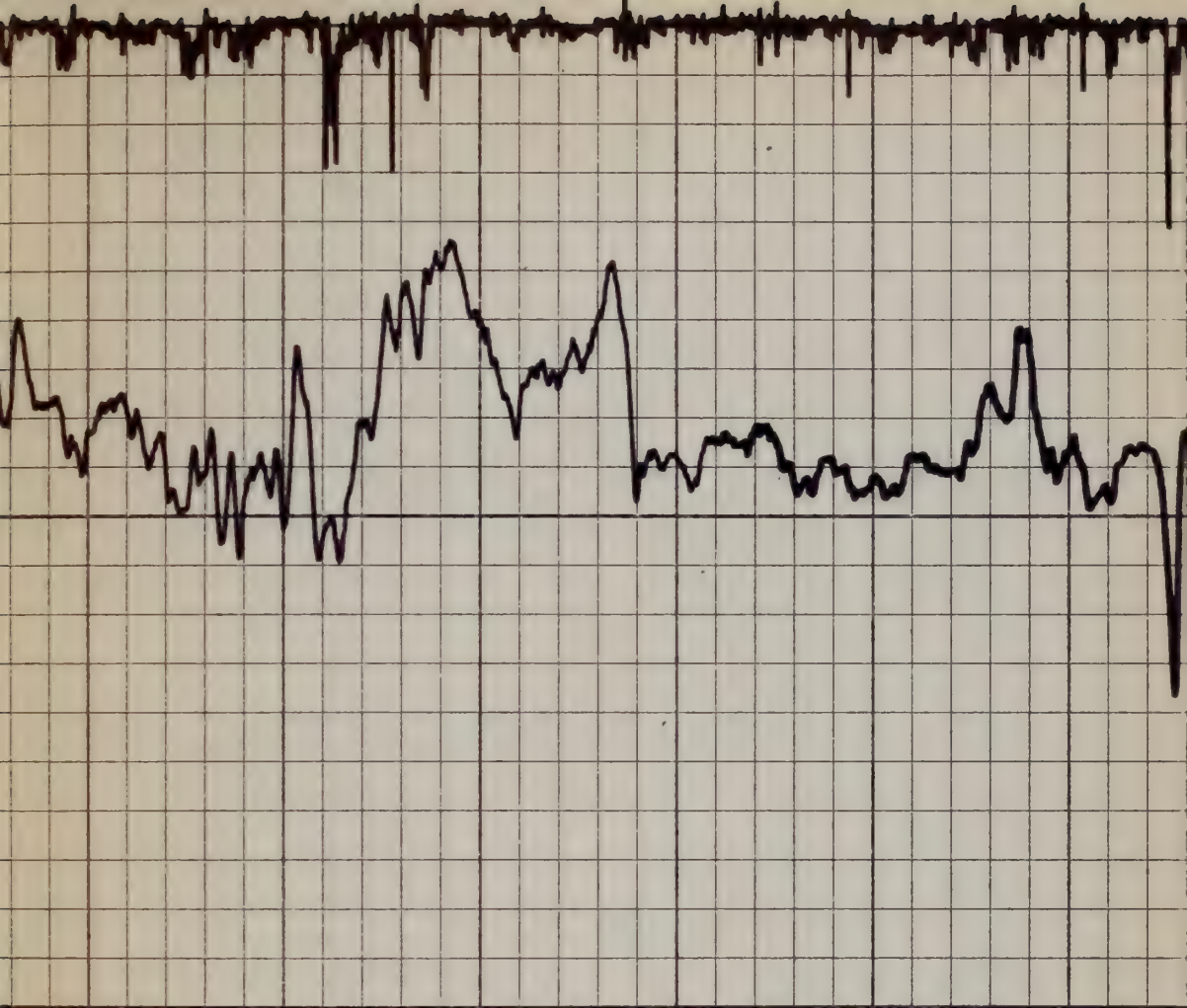


50

100

200

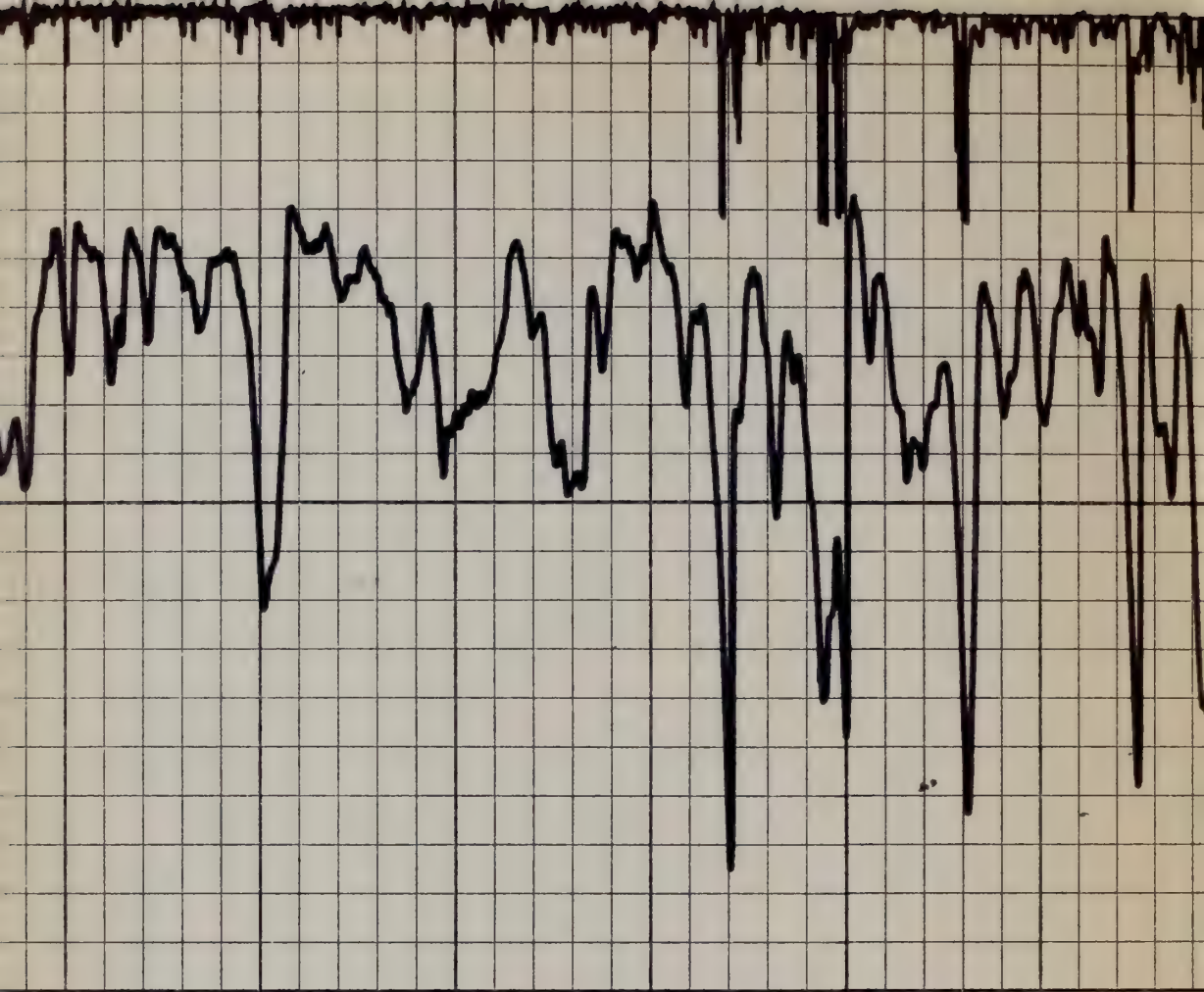




600

700

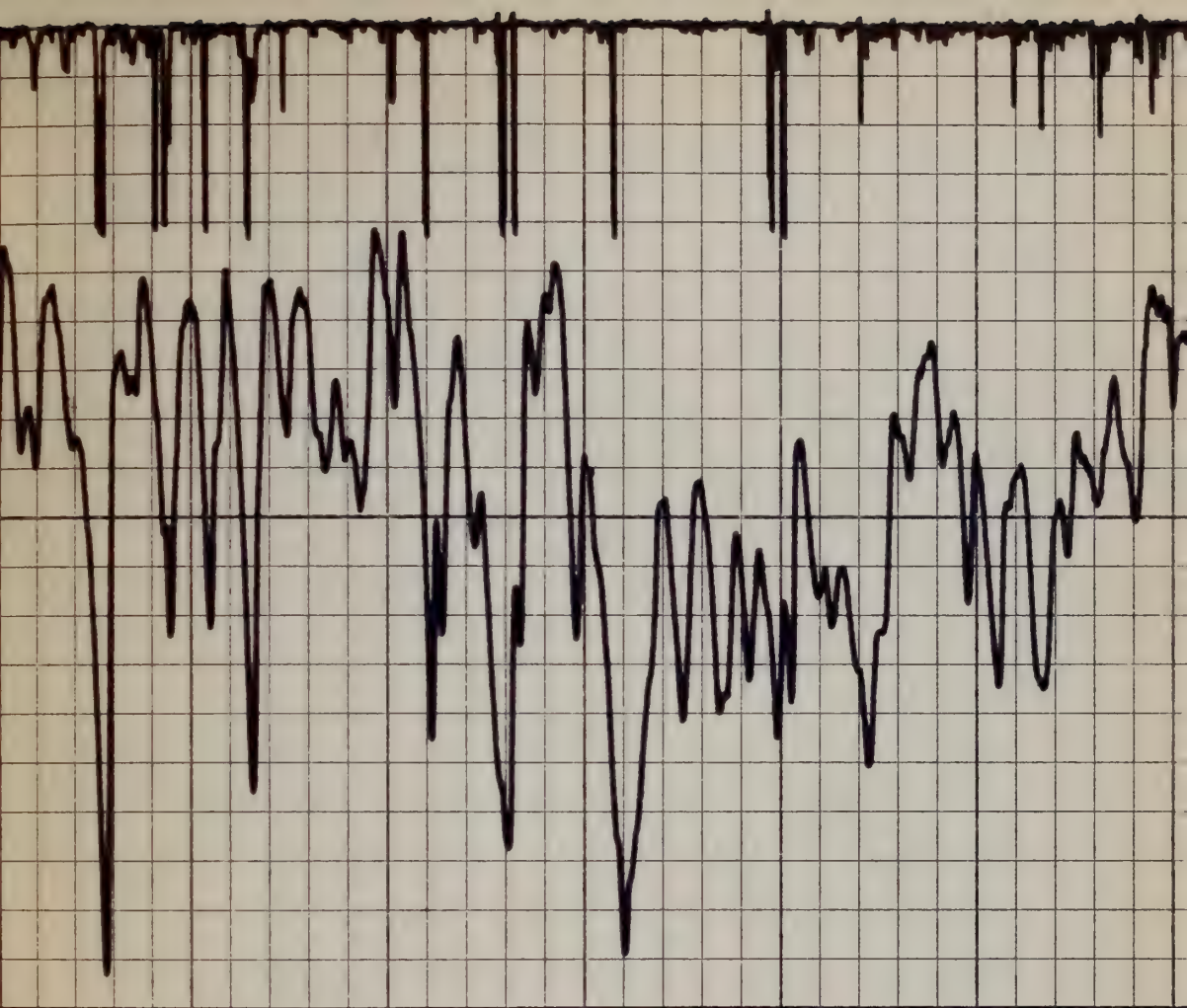
800



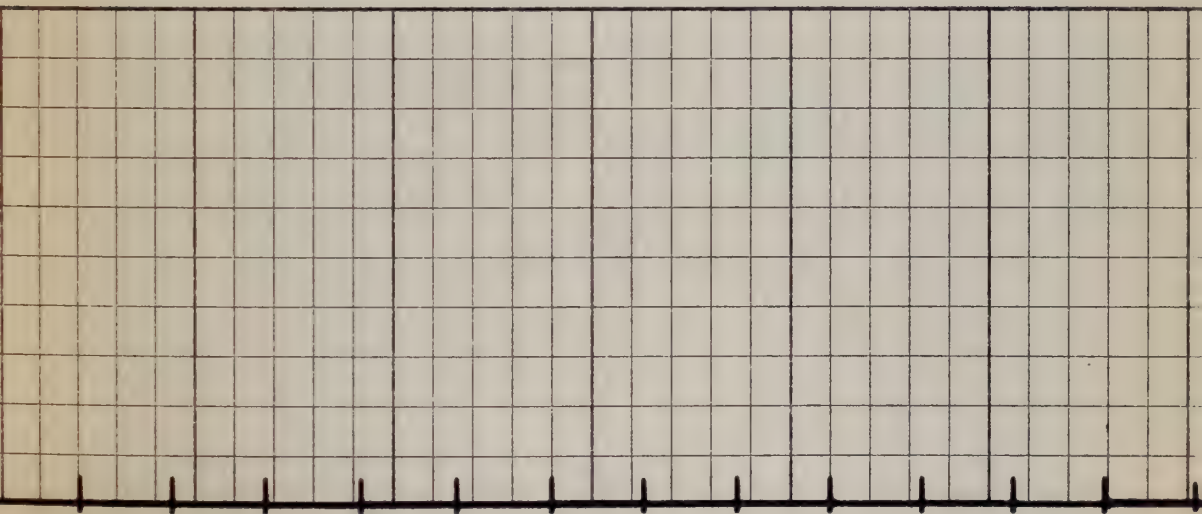
900

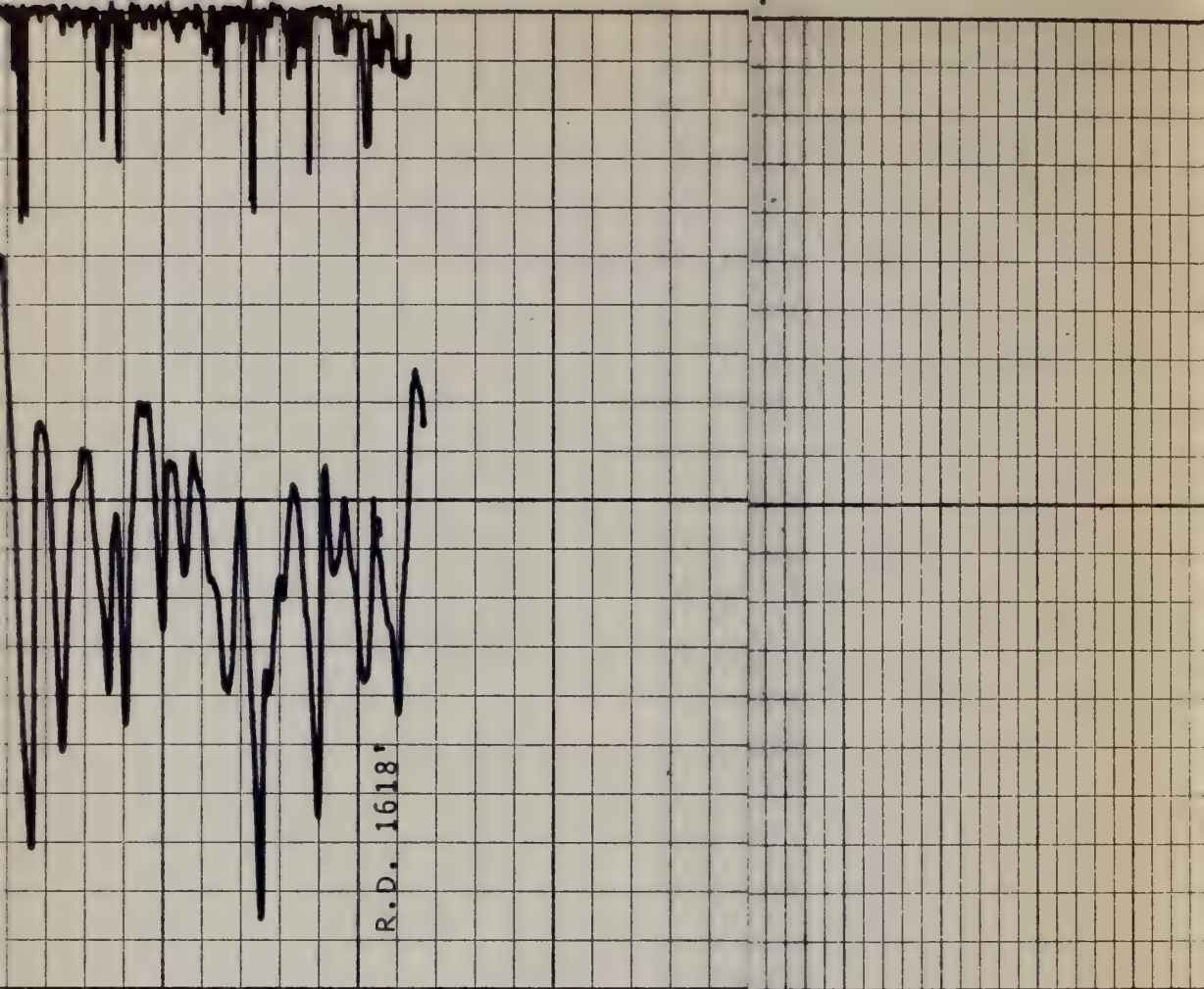
1000

1100



1200
1300
1400
1500





R.D. 1618'

1600
T.D.
1620'

CALIBRATION DATA

AFTER LOG

PI

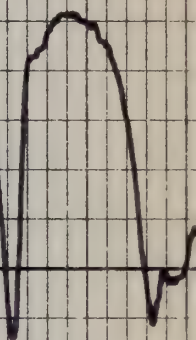
1"

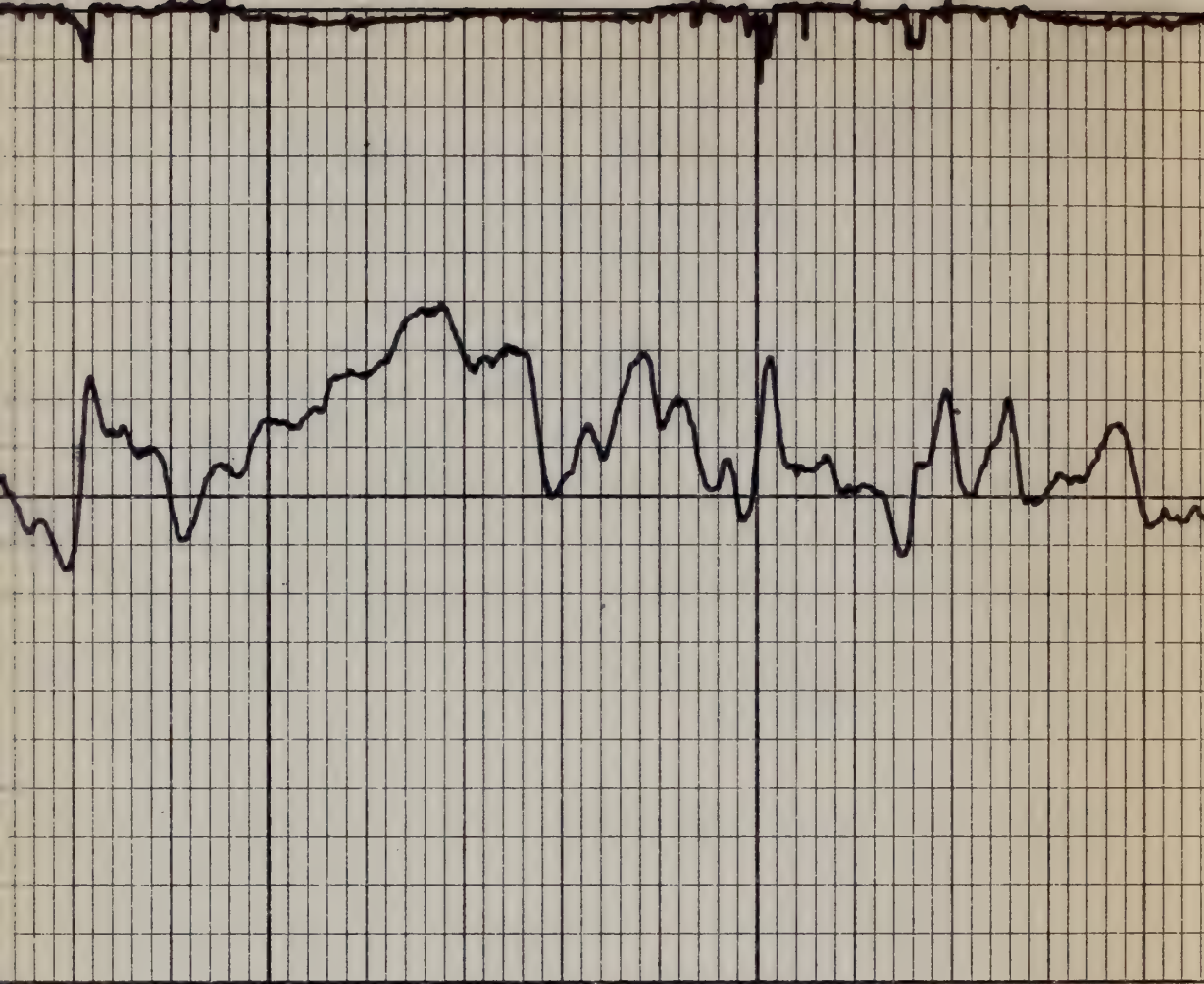
25K

FDL

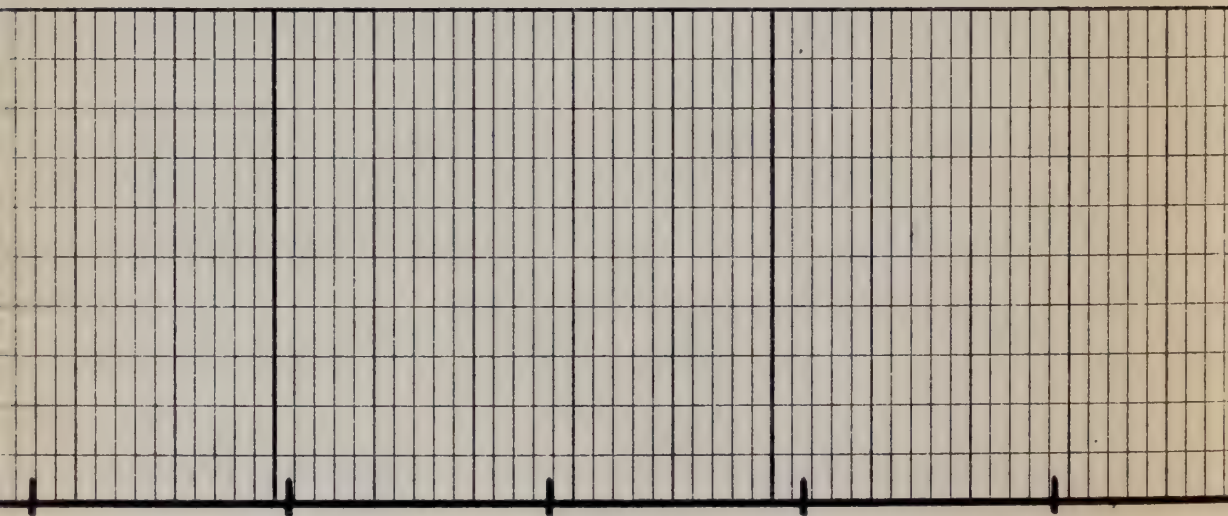
50K

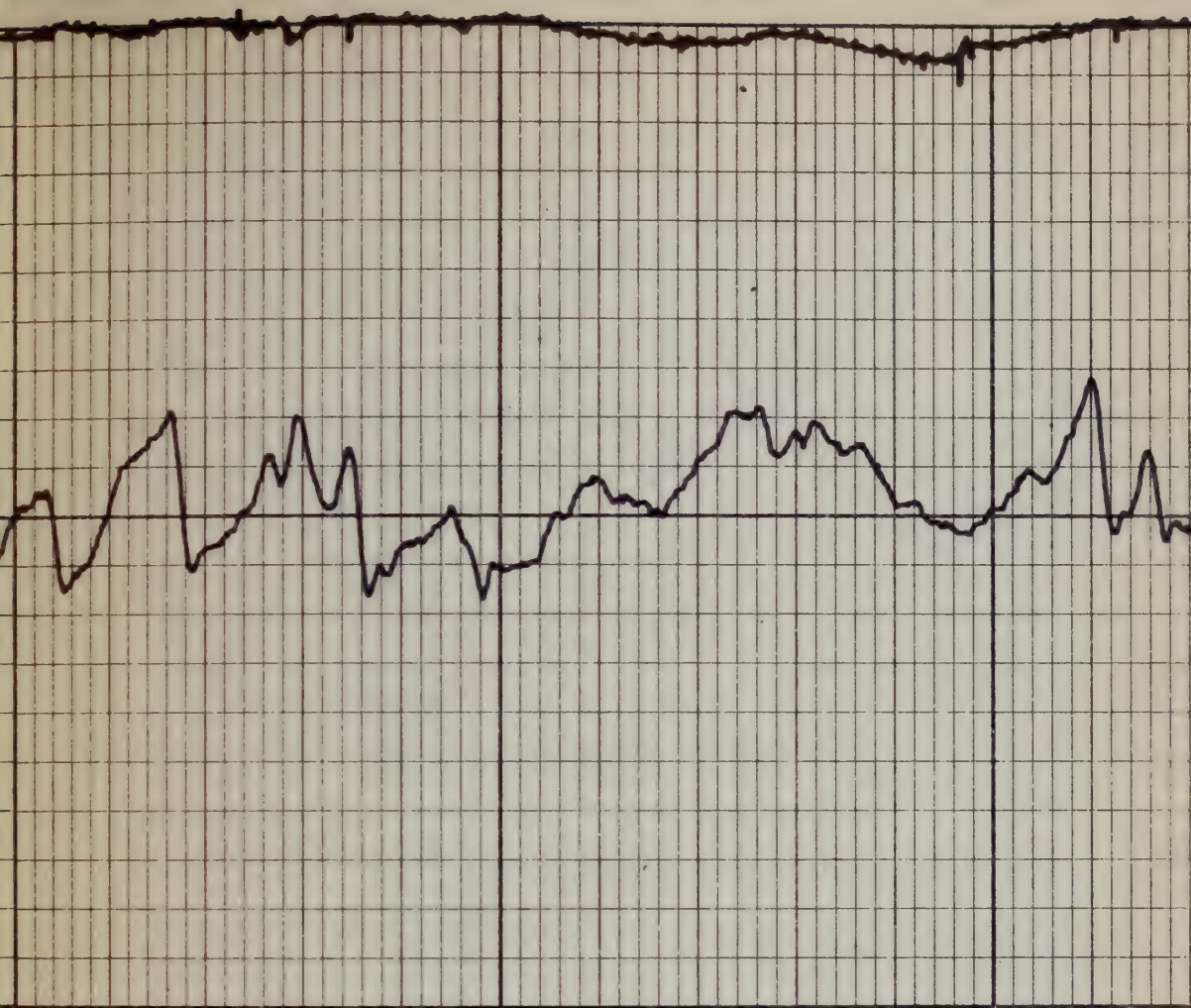
50





100



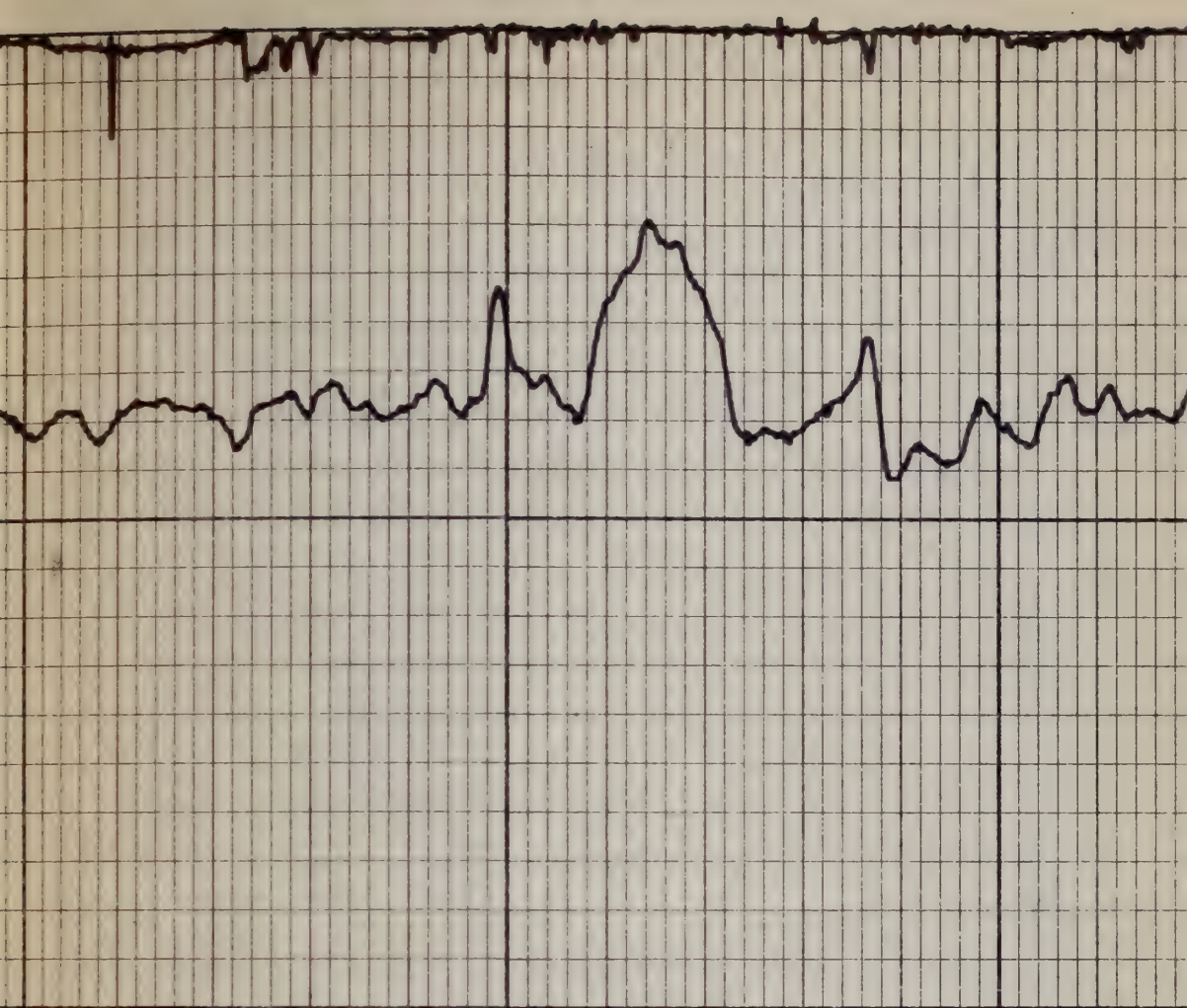


200

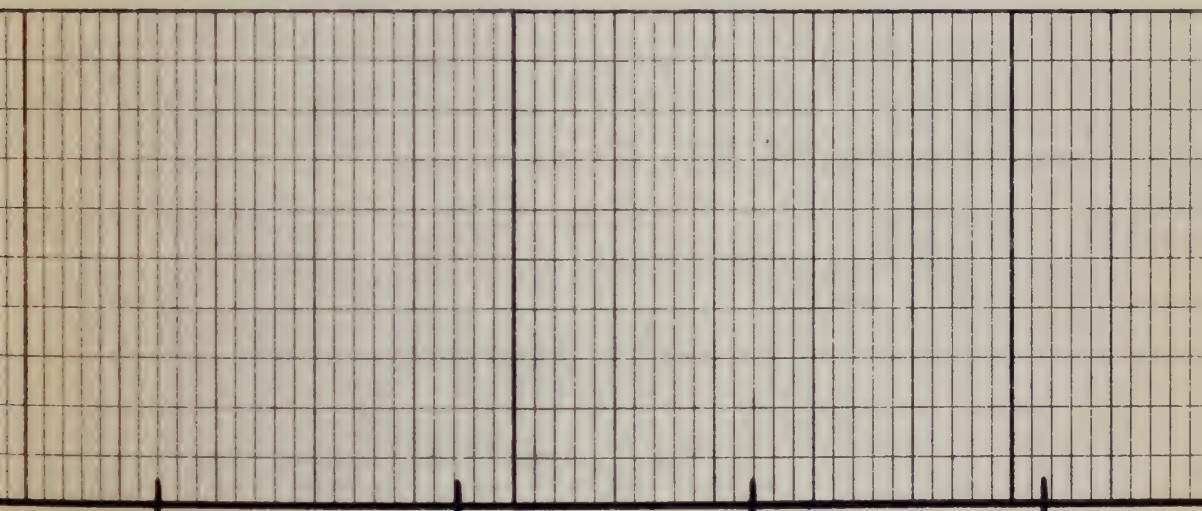
300

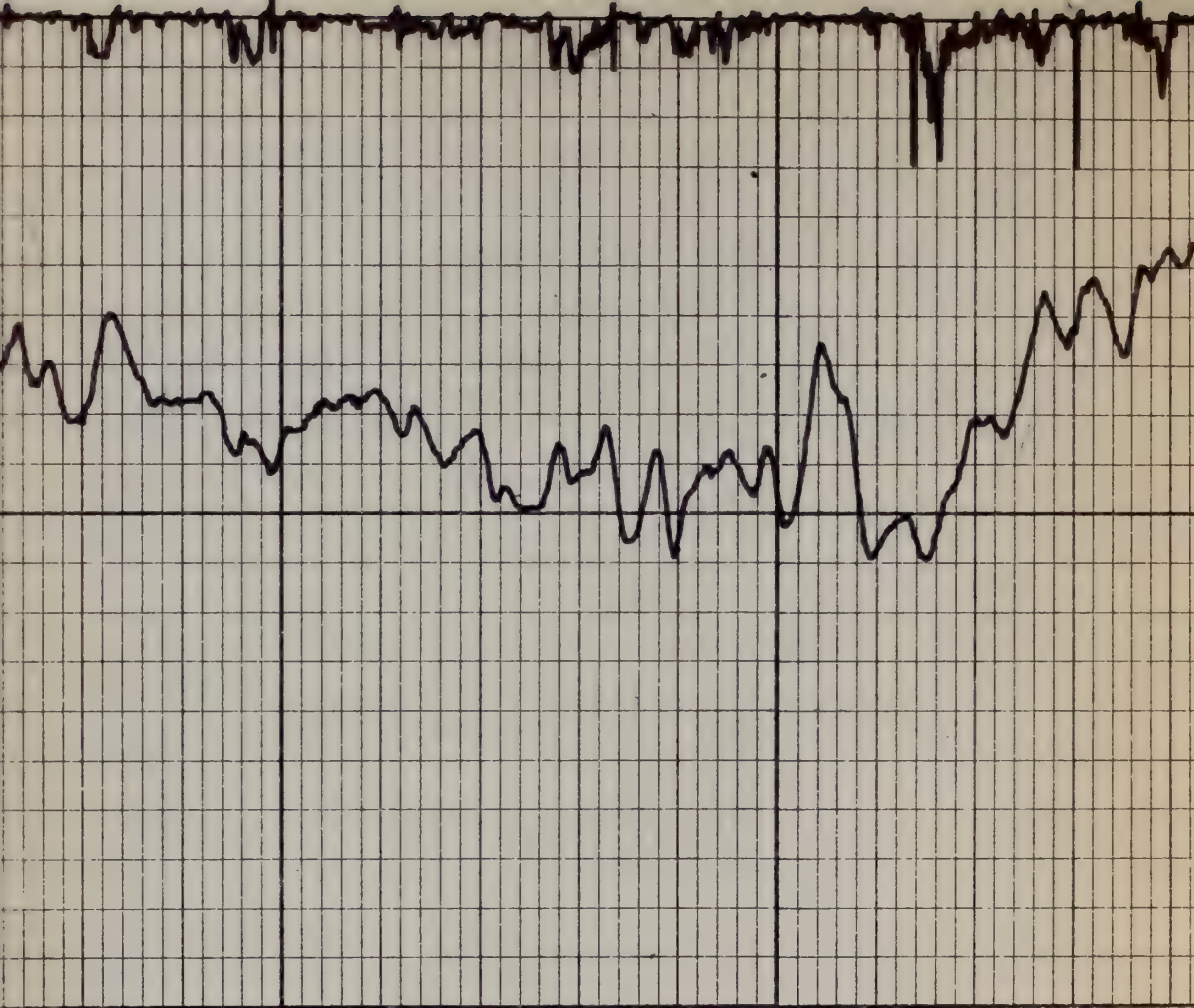


400

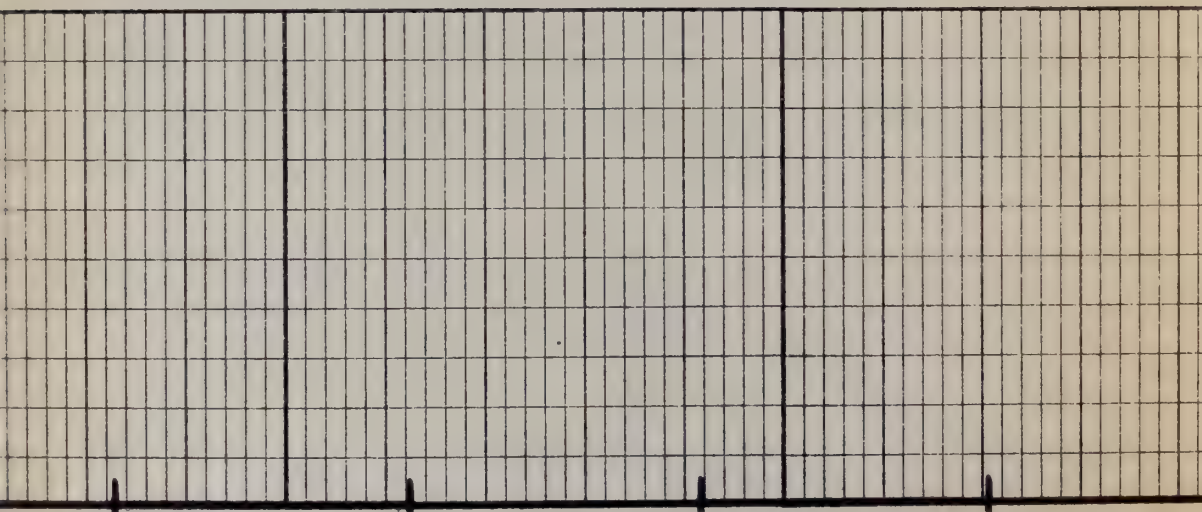


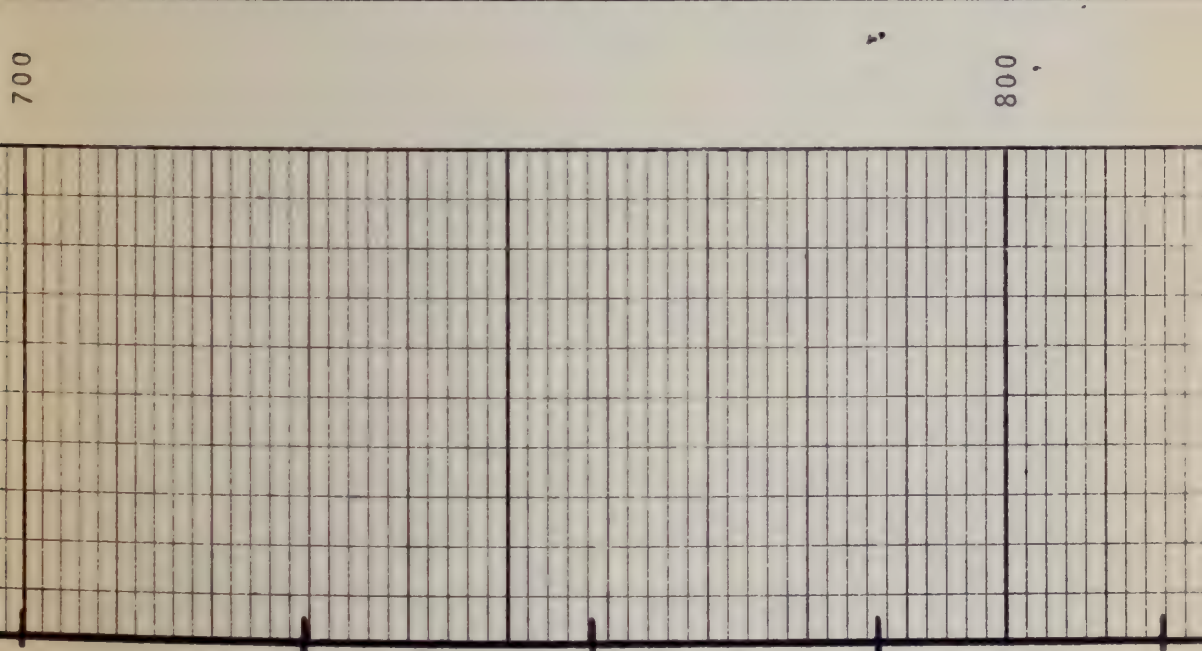
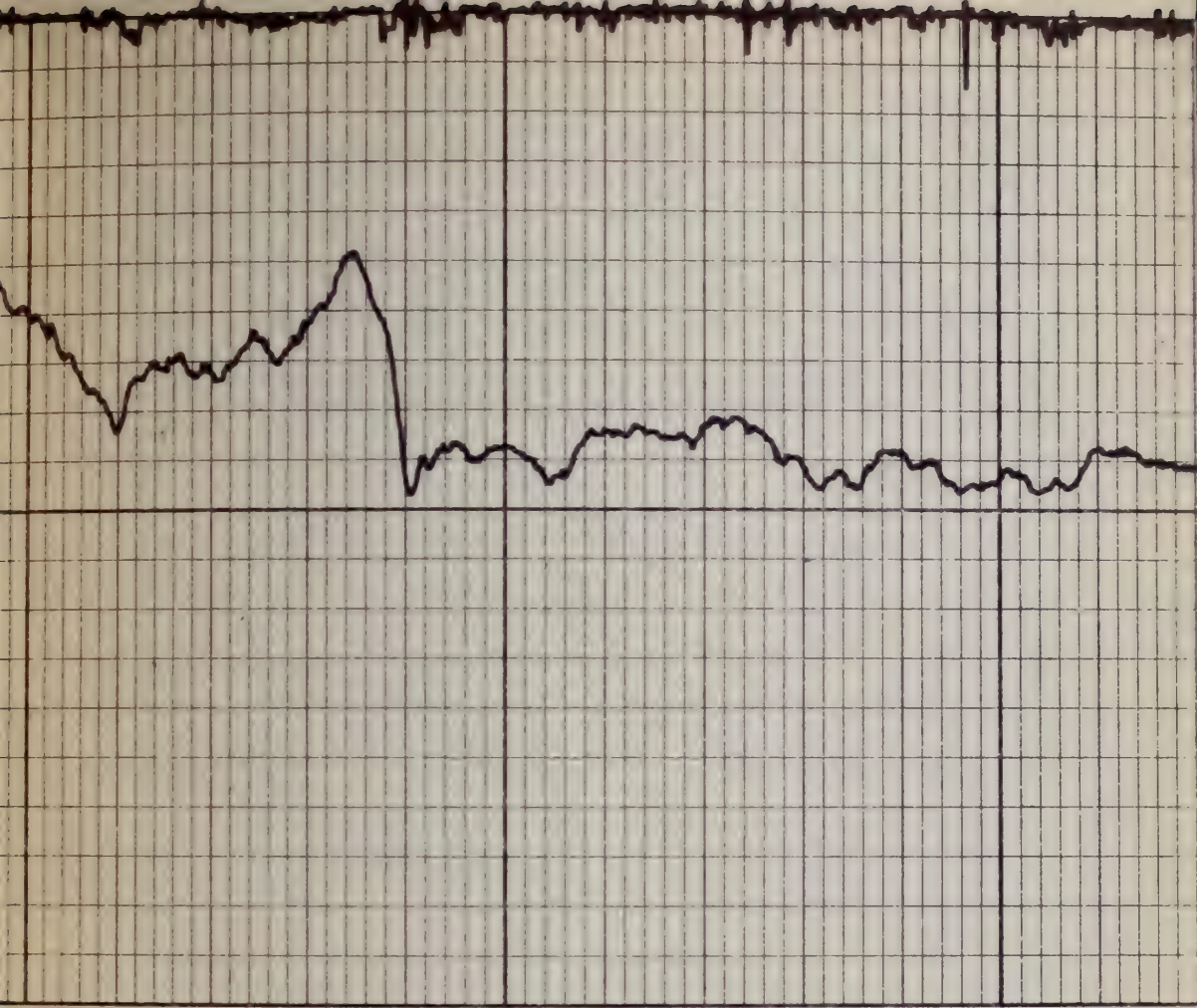
500





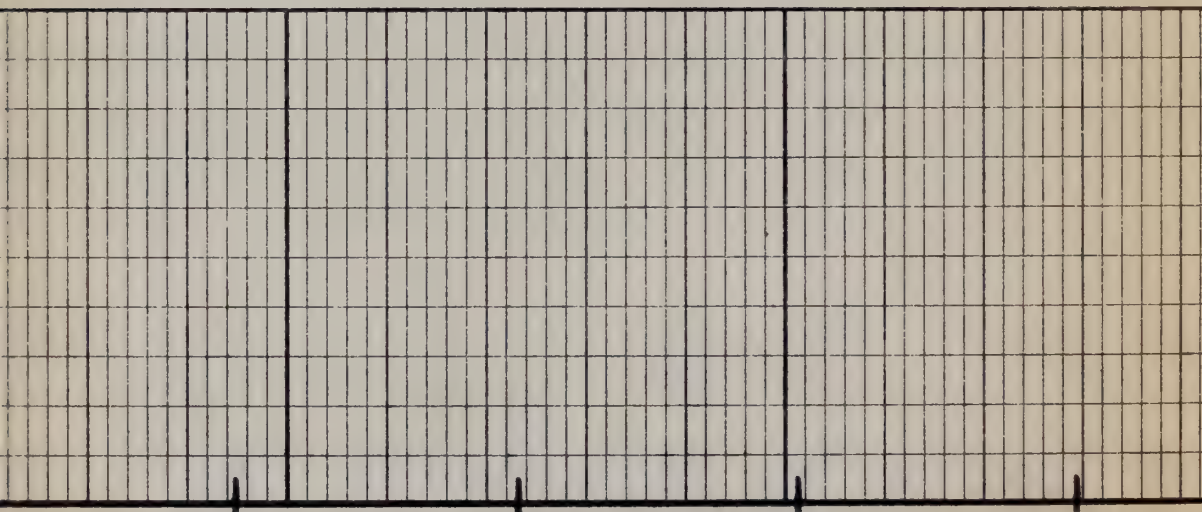
600

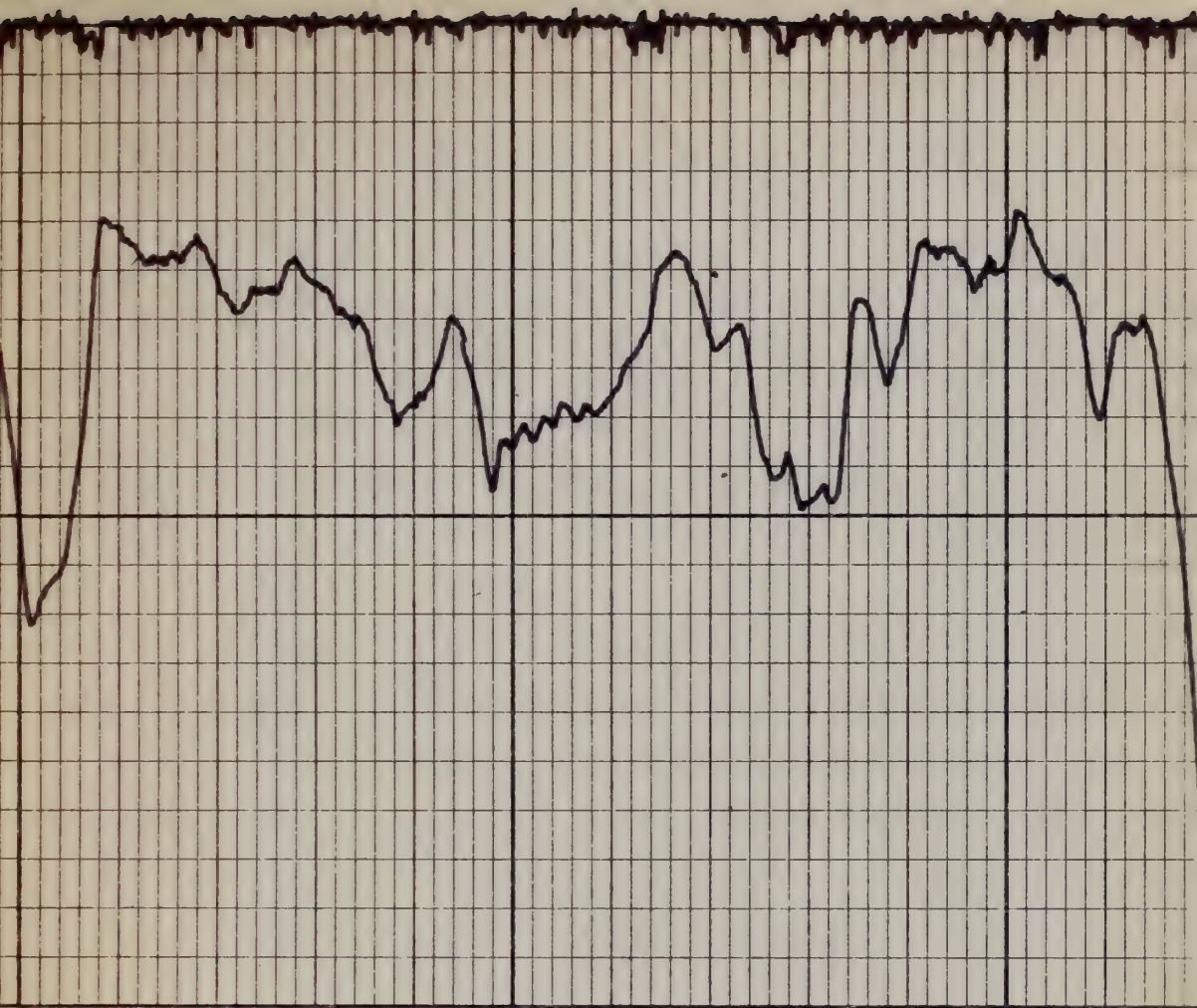




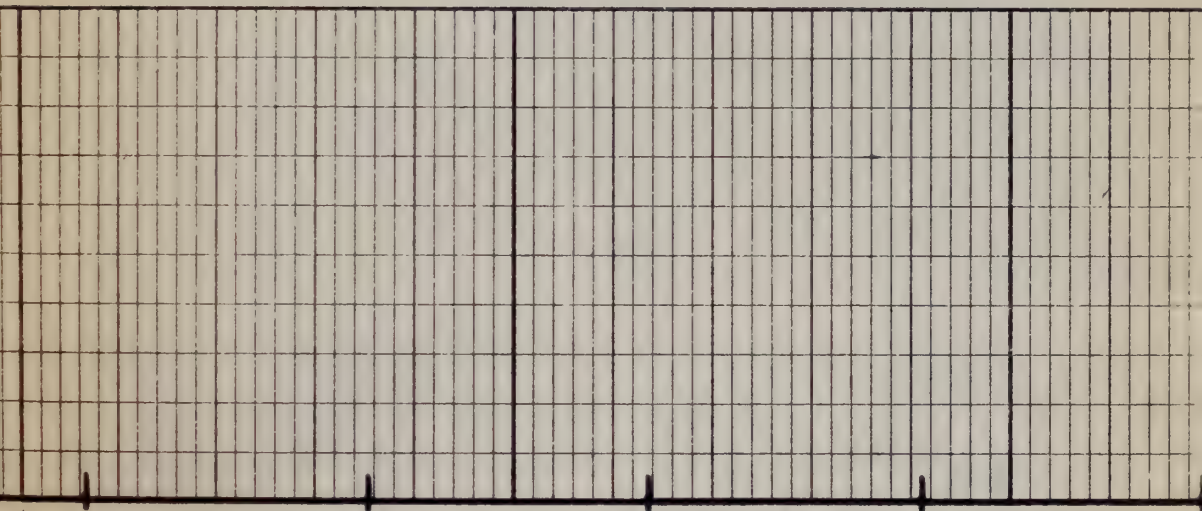


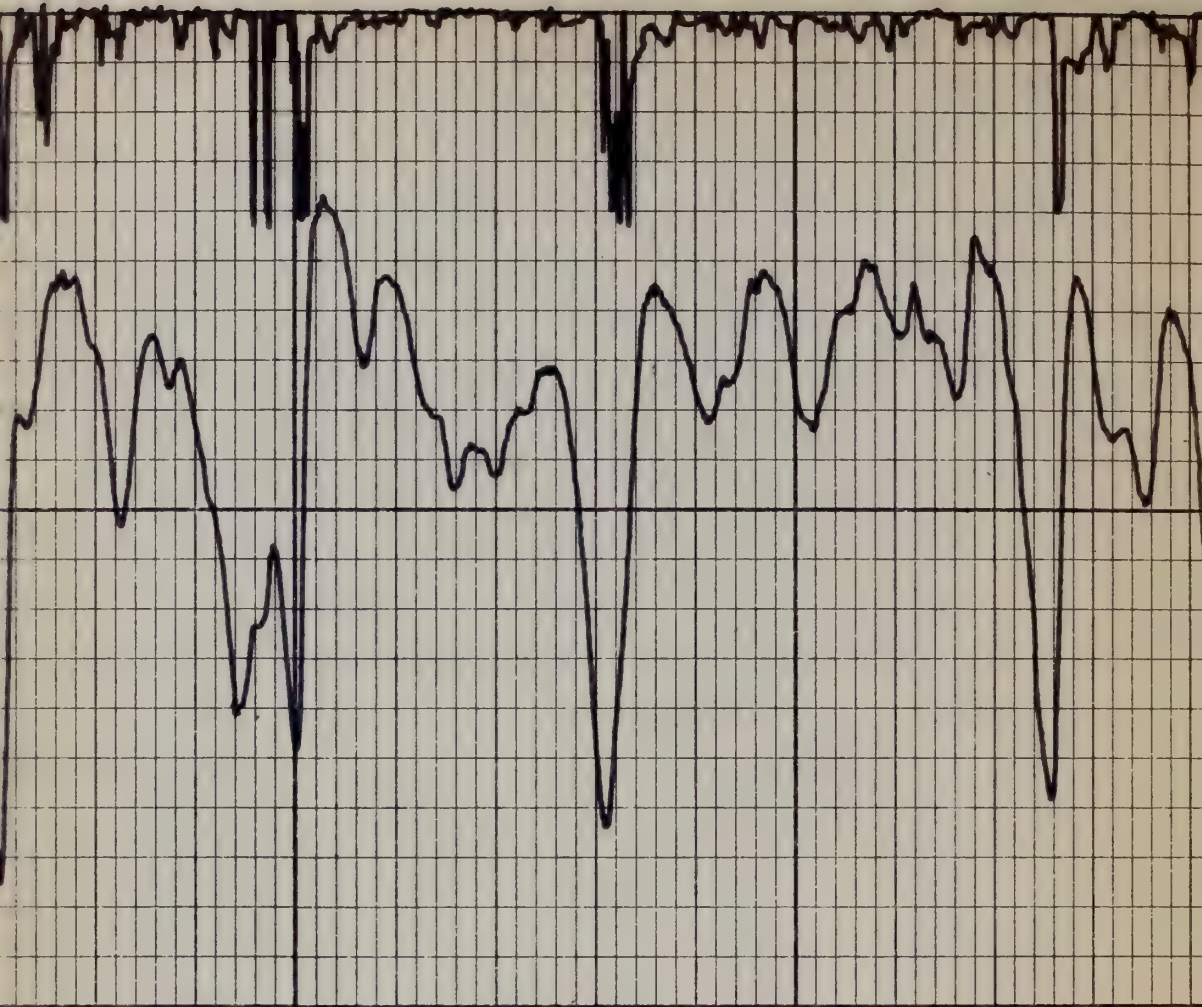
900



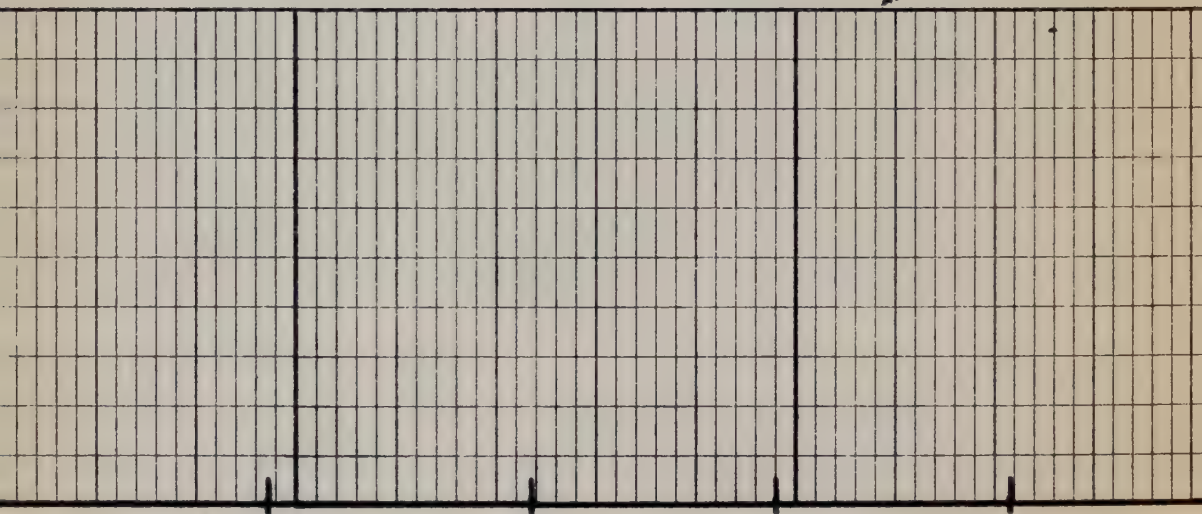


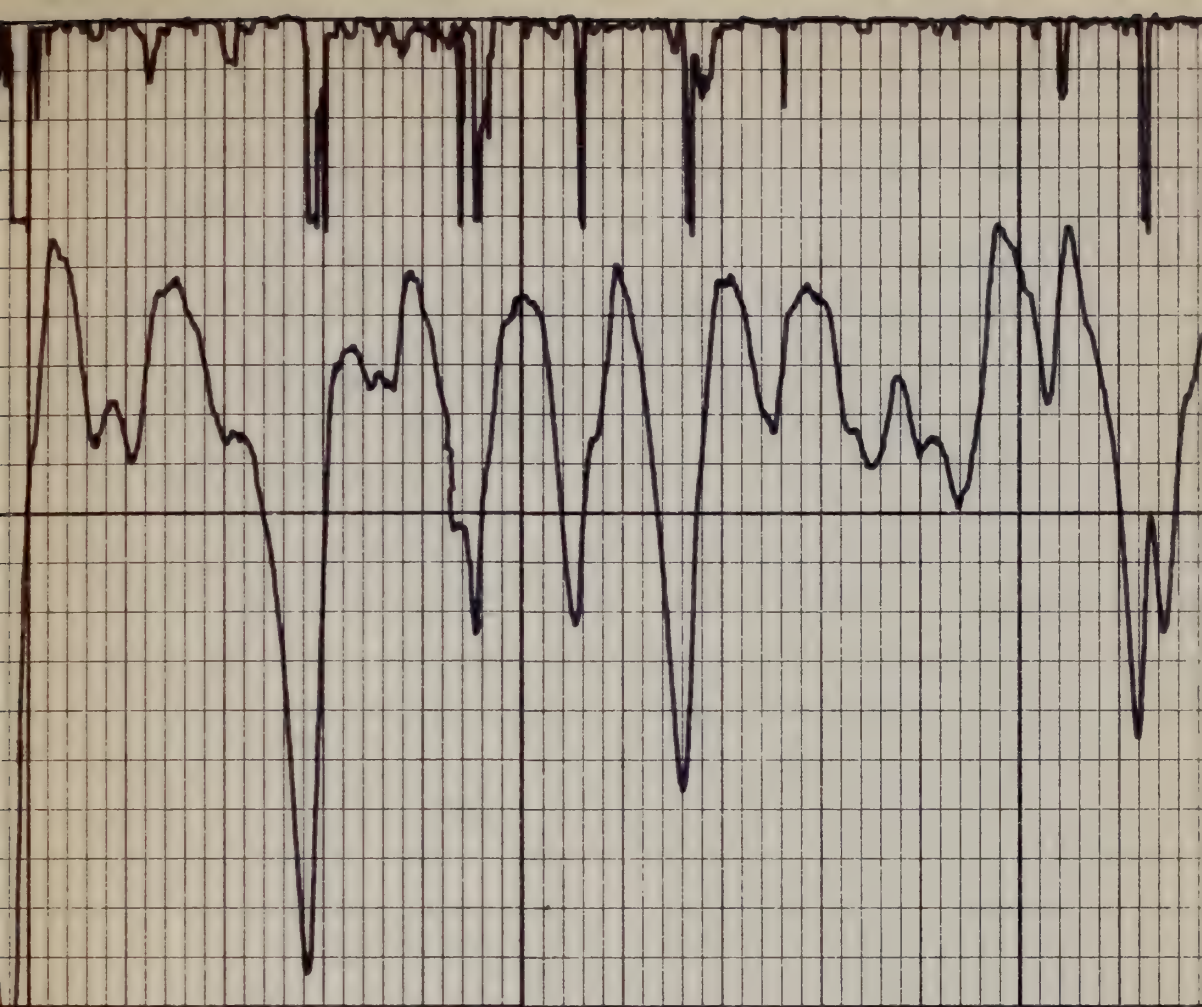
1000





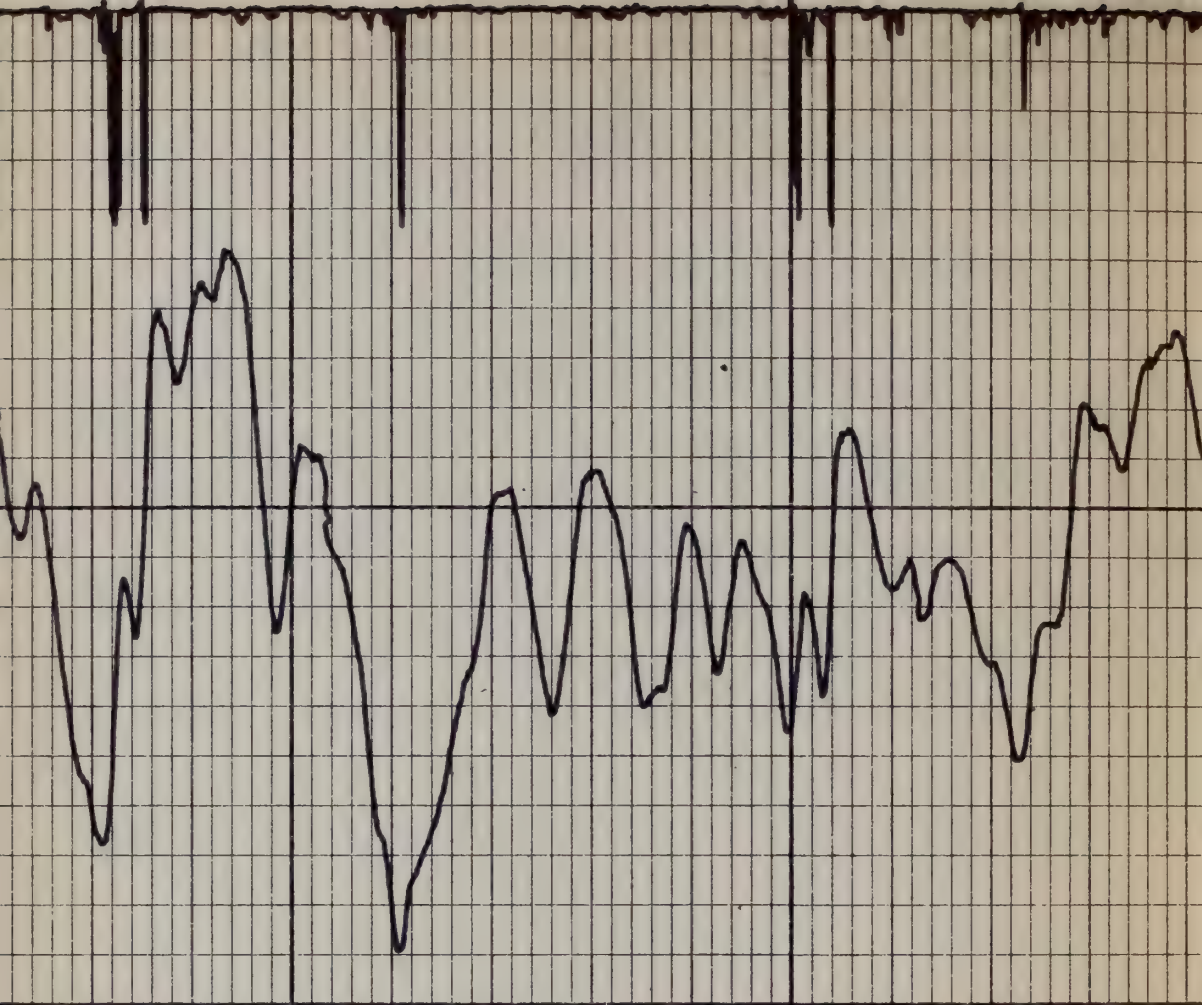
1100



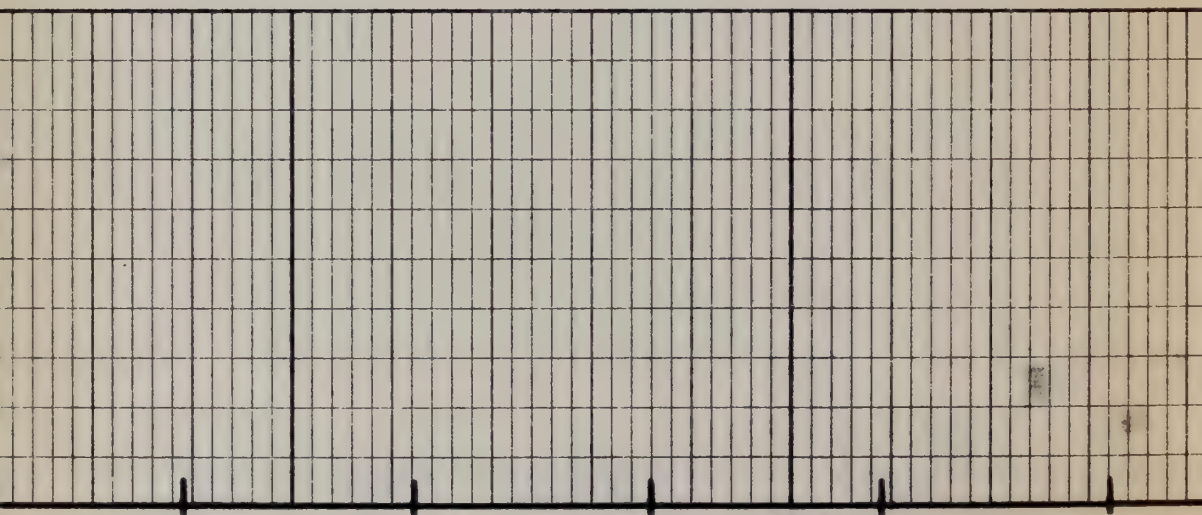


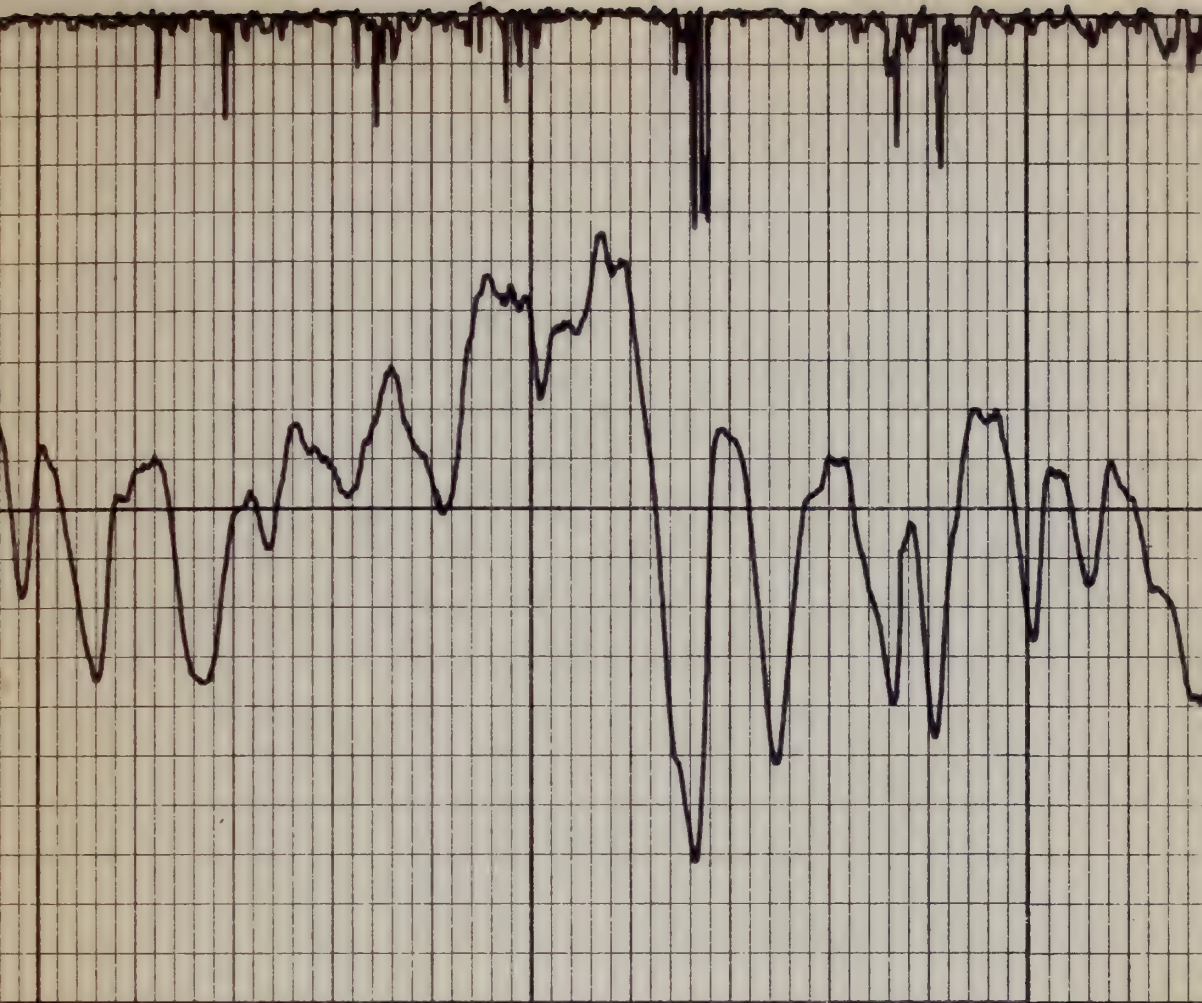
1200

1300

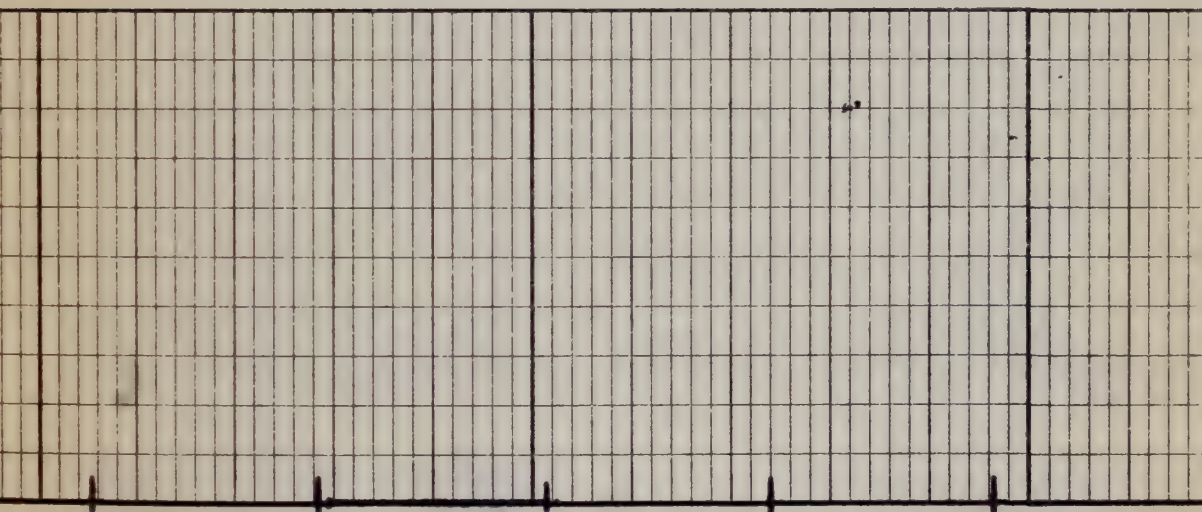


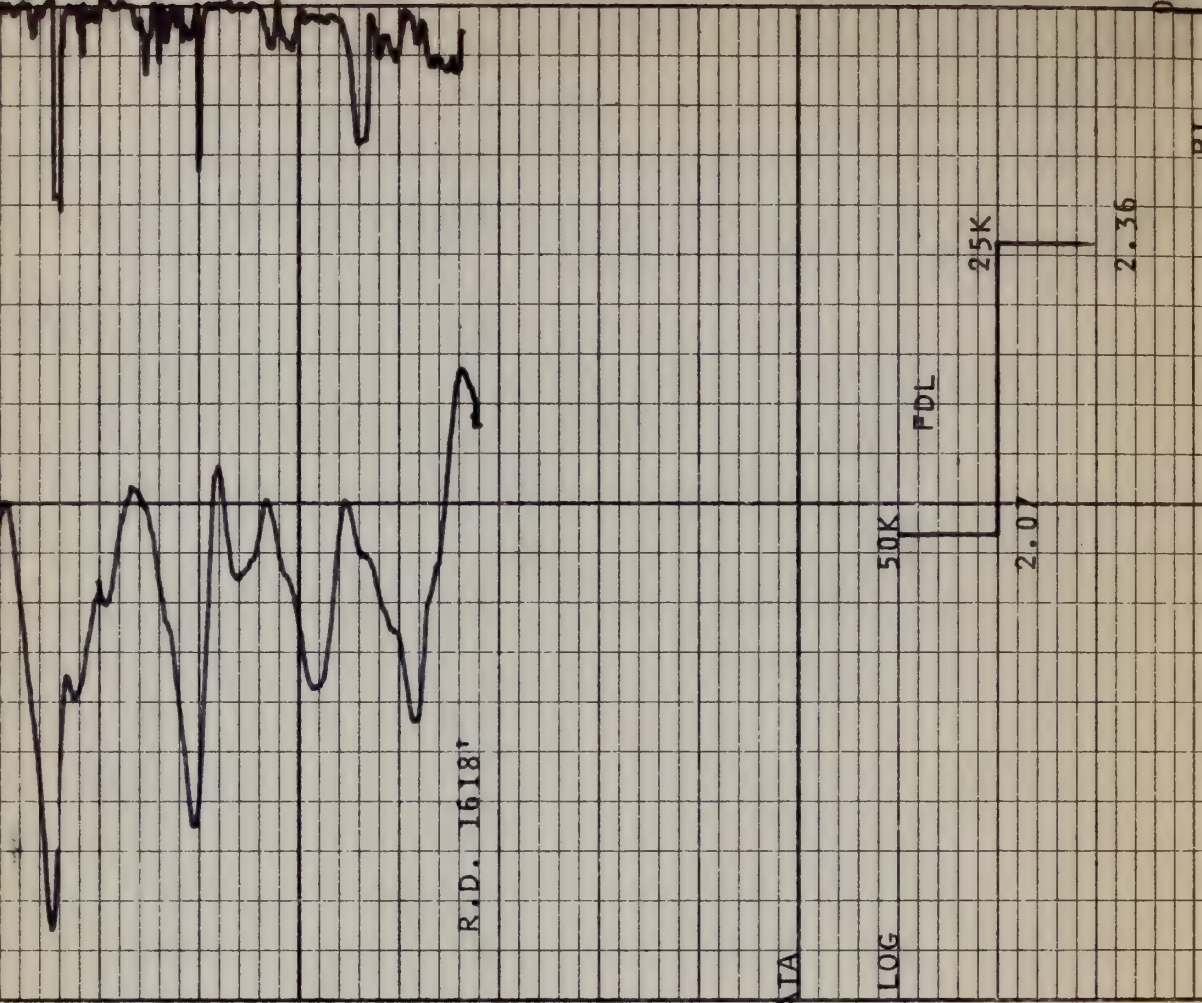
1400





1500





1600

T.D.
1620'

CALIBRATION DATA

BEFORE LOG

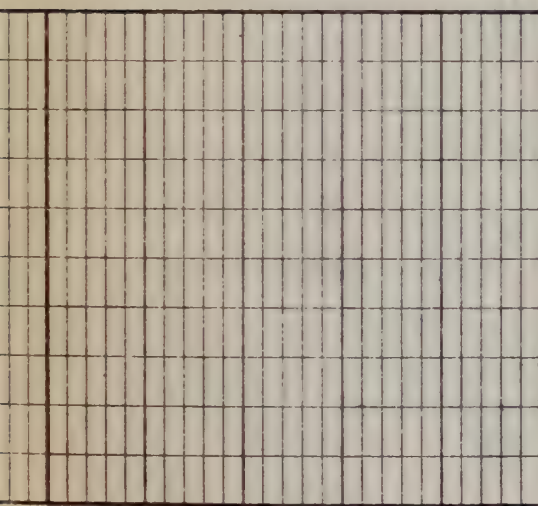
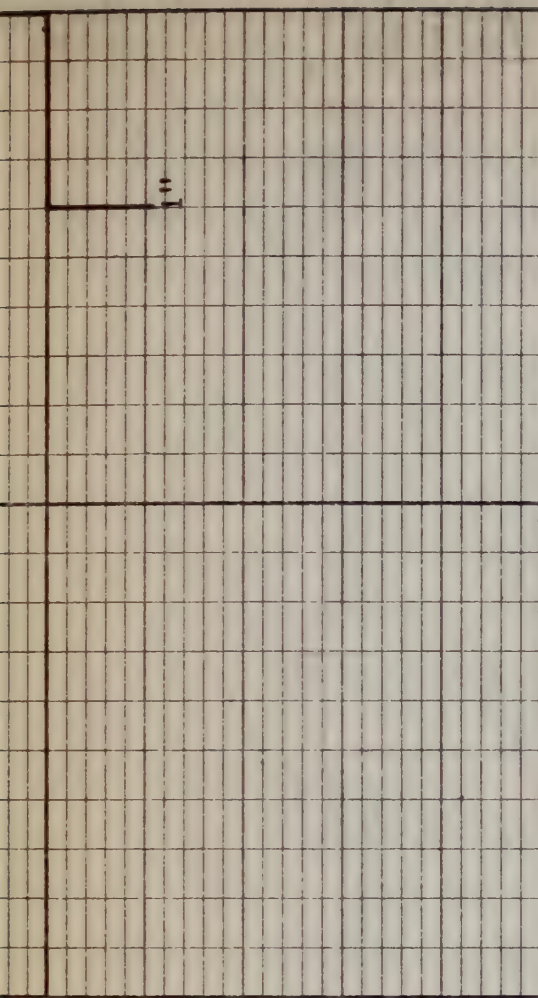
50K

FDL

25K

2.07

2.36





Birdwell

Nuclear Log

COMPANY ATLANTIC RICHFIELD COMPANY,
ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD _____

COUNTY RIO BLANCO STATE COLORADO

LOCATION: _____

OTHER SERVICES

V3D CAL FDL
TL ES

SEC. - 7 TWP. 3S RGE. 96W

ELEVATIONS:

PERMANENT DATUM GROUND LEVEL, ELEV. 6909'

KB. _____

LOG MEASURED FROM GL, _____ ft. above perm. datum

DF. _____

DRILLING MEASURED FROM GL

GL. 6909'

DATE	2 JULY 74	
RUN NO.	1	1
TYPE LOG	GR	ENP
DEPTH - DRILLER	1621	1621
DEPTH - LOGGER	1620	1620
BOTTOM LOGGED INTERVAL	1609	1618
TOP LOGGED INTERVAL	0	10
TYPE FLUID IN HOLE	WATER	WATER
SALINITY PPM CL.		
DENSITY LB./GAL.		
LEVEL	412	412
MAX. REC. TEMP. - DEG. F	78°	78°
OPERATING RIG TIME	1 HOUR TOTAL TIME	
RECORDED BY	WILSON	WILSON
WITNESSED BY	TAIT	TAIT
LOCATION	LAS VEGAS	LAS VEGAS

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1				7"		0	62'
	6-1/4"	62'	1621'				

EQUIPMENT DATA

GAMMA RAY

NEUTRON

RUN NO.	1	RUN NO.	1
TOOL MODEL NO.	LAAB	LOG TYPE	ENP
DIAMETER	3-5/8"	TOOL MODEL NO.	LABB
DETECT. MODEL NO.	MG-70 HIT	DIAMETER	3-5/8"
TYPE	GM	DETECT. MODEL NO.	9373 TN
LENGTH	12"	TYPE	GM
DIST. TO N. SOURCE	9'	LENGTH	6"
GENERAL		SOURCE MODEL NO.	MRC
TRUCK NO.	2694	SERIAL NO.	289
		SPACING	15.5"
		TYPE	PU:8BE
TOOL SERIAL NO.		STRENGTH-N/SEC.	.72X10 ⁷

LOGGING DATA

GENERAL

GAMMA RAY

NEUTRON

RUN NO.	DEPTHS		SPEED FT/MIN	T.C. SEC.	CPM FULL SCALE	ZERO DIV. L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	CPM FULL SCALE	ZERO DIV. L OR R	N. UNITS PER LOG DIV.
	FROM	TO									
1	1609	0	20	3	20X10 ³	0	20		50X10 ³		3%/DIV.
	1618	10	20					3			

REFERENCE LITERATURE:

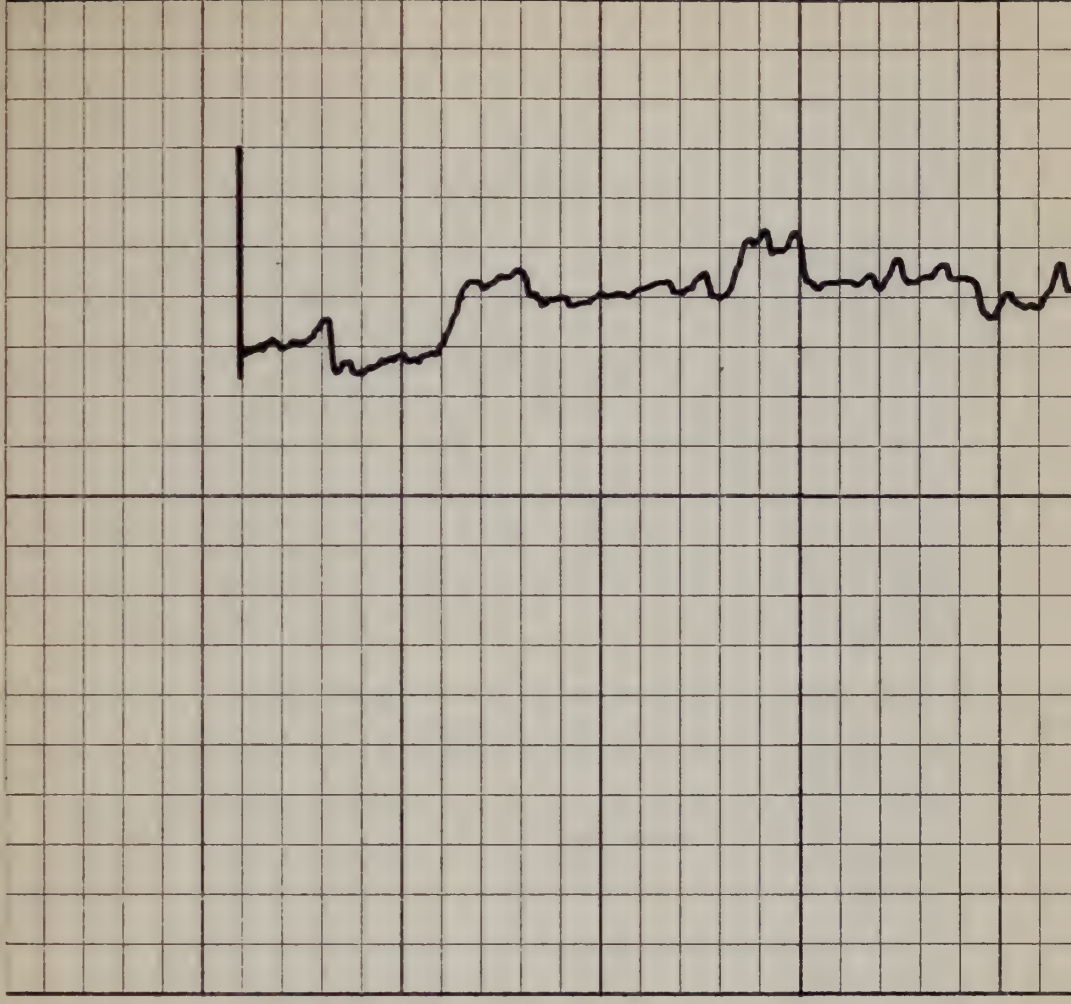
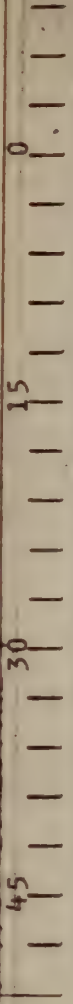
REMARKS: THIS WORK WAS PERFORMED UNDER UNITED STATES ATOMIC ENERGY COMMISSION
BY-PRODUCT MATERIAL LICENSE NO. 35-05651-01 AND SPECIAL NUCLEAR MATERIALS LICENSE NO. SNM-161

GAMMA RAY

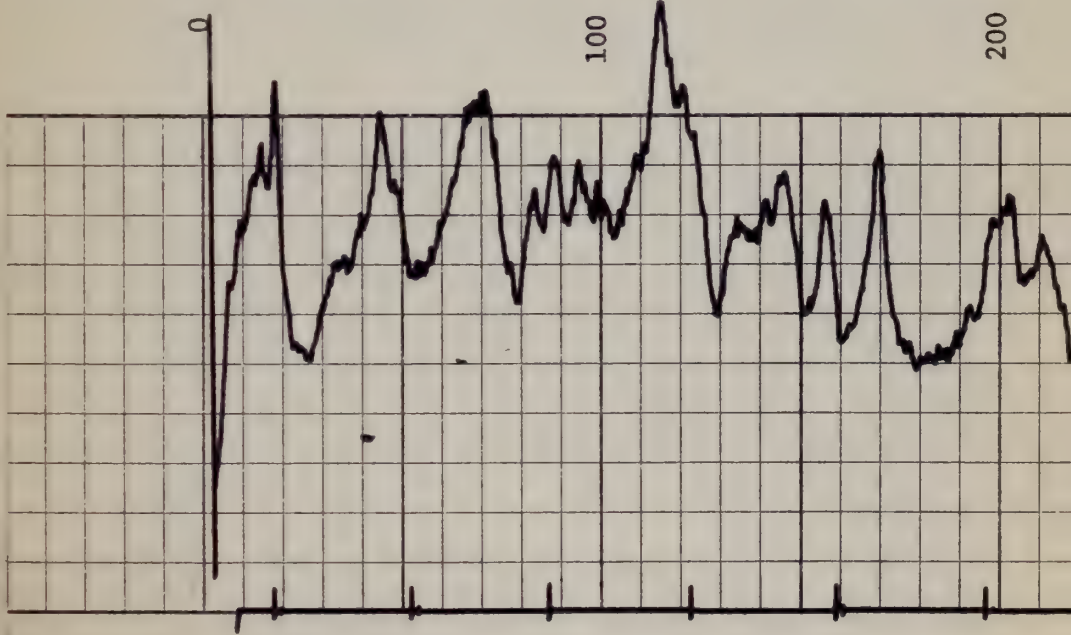
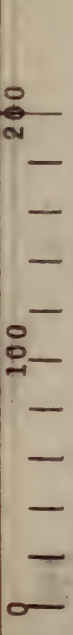
DEPTH

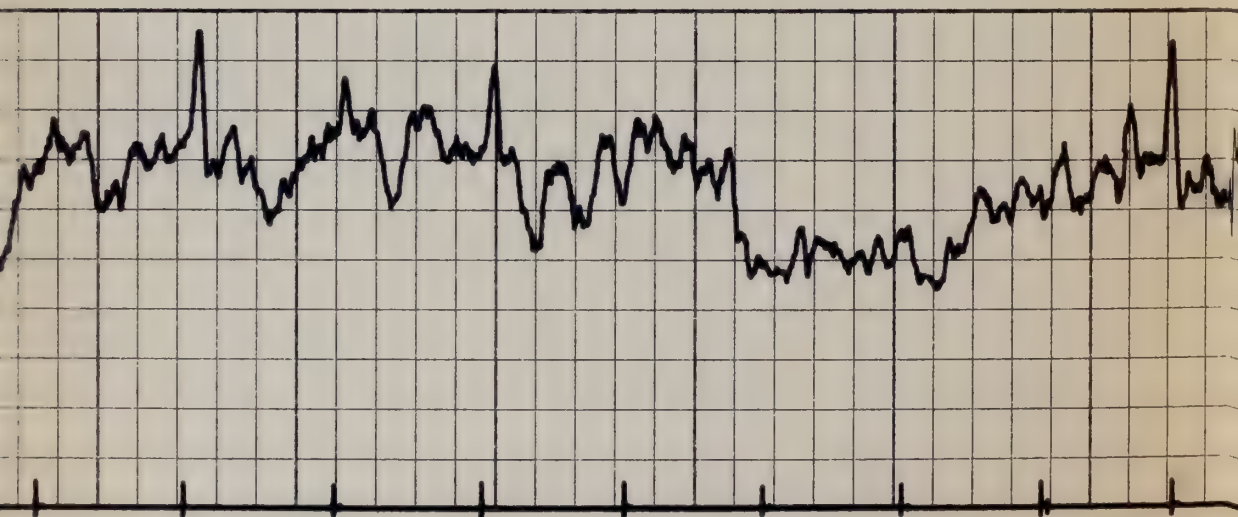
NEUTRON

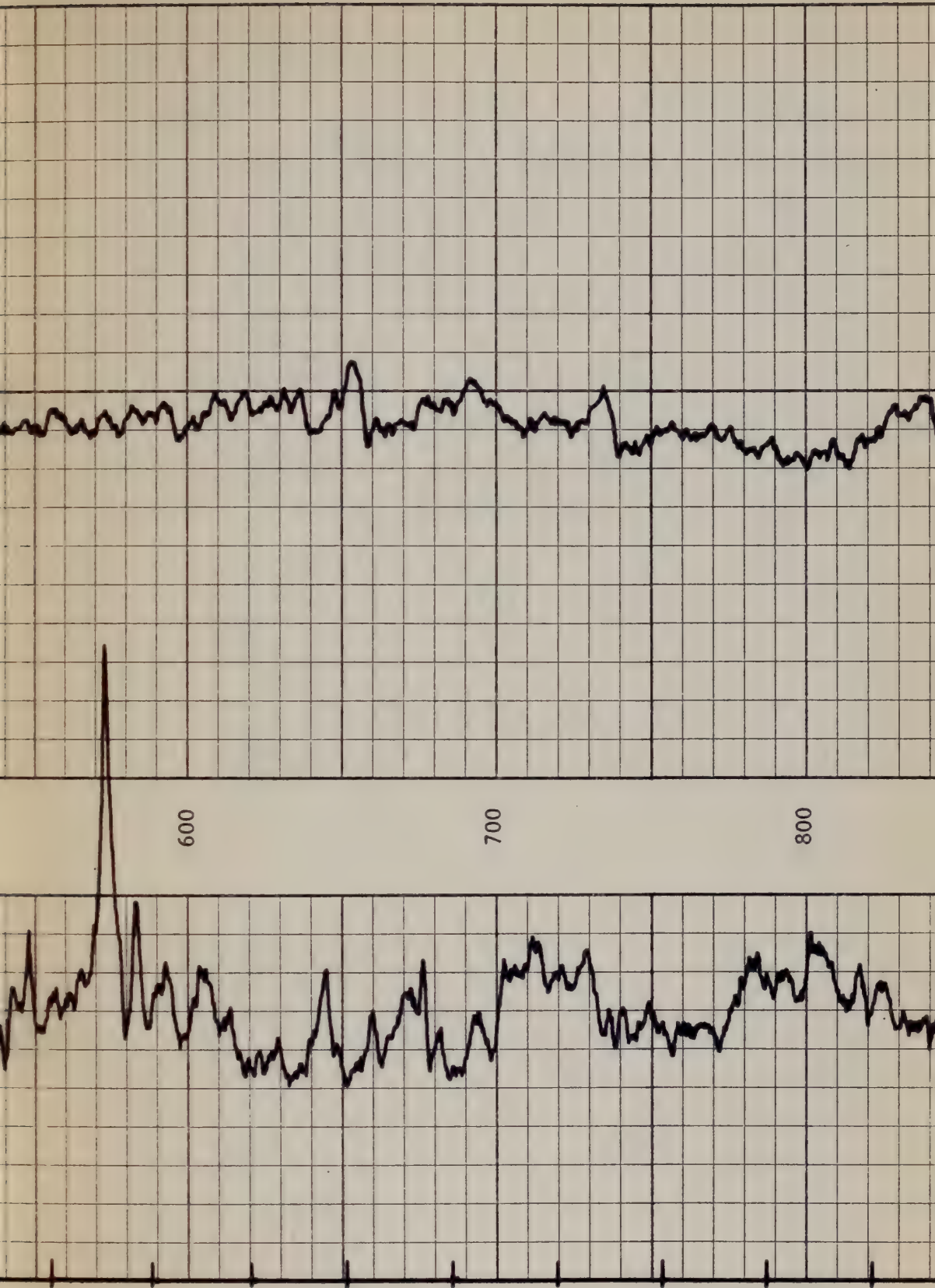
7-7/8" LIMESTONE ϕ NEUTRON UNITS

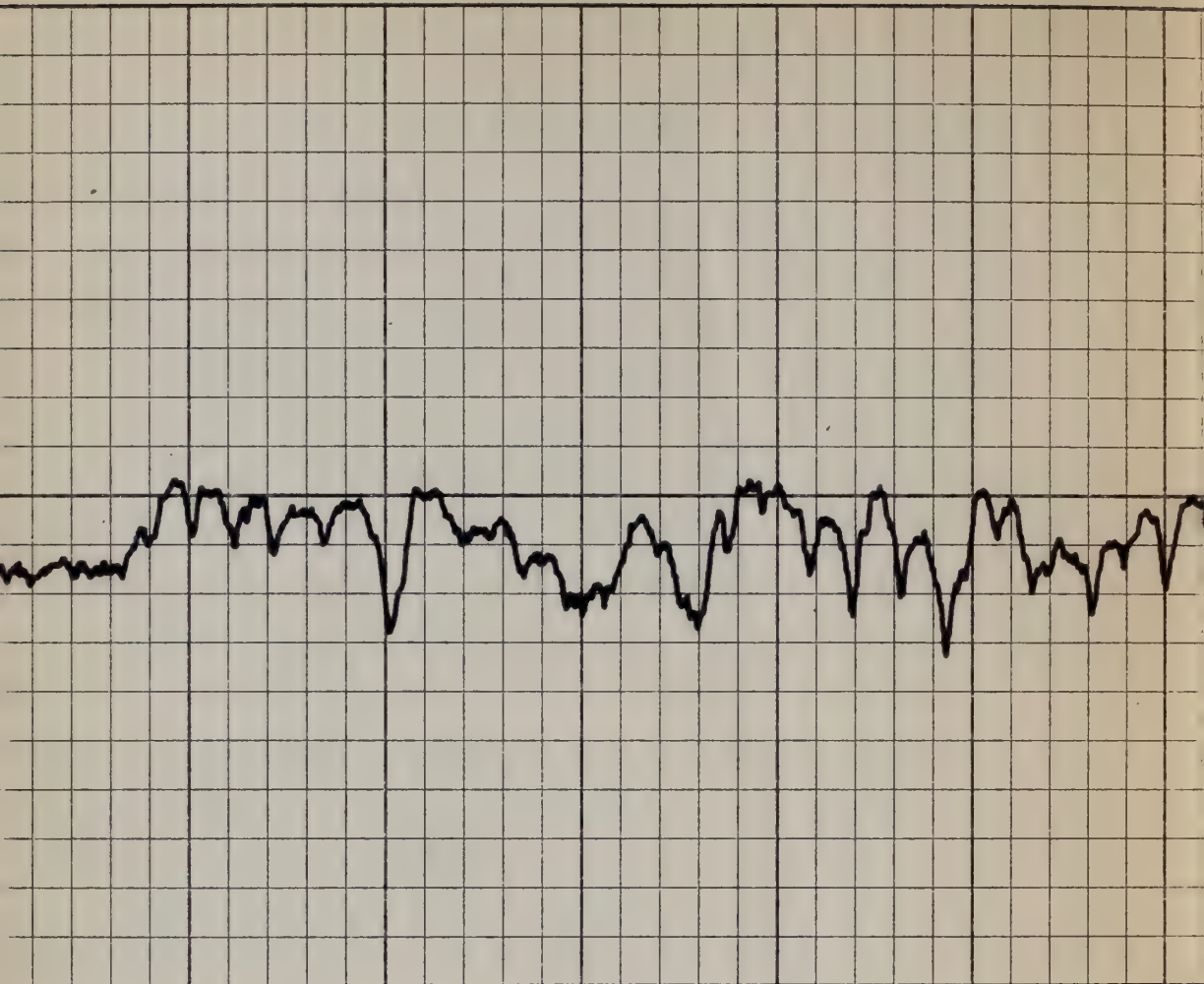


API GAMMA RAY UNITS





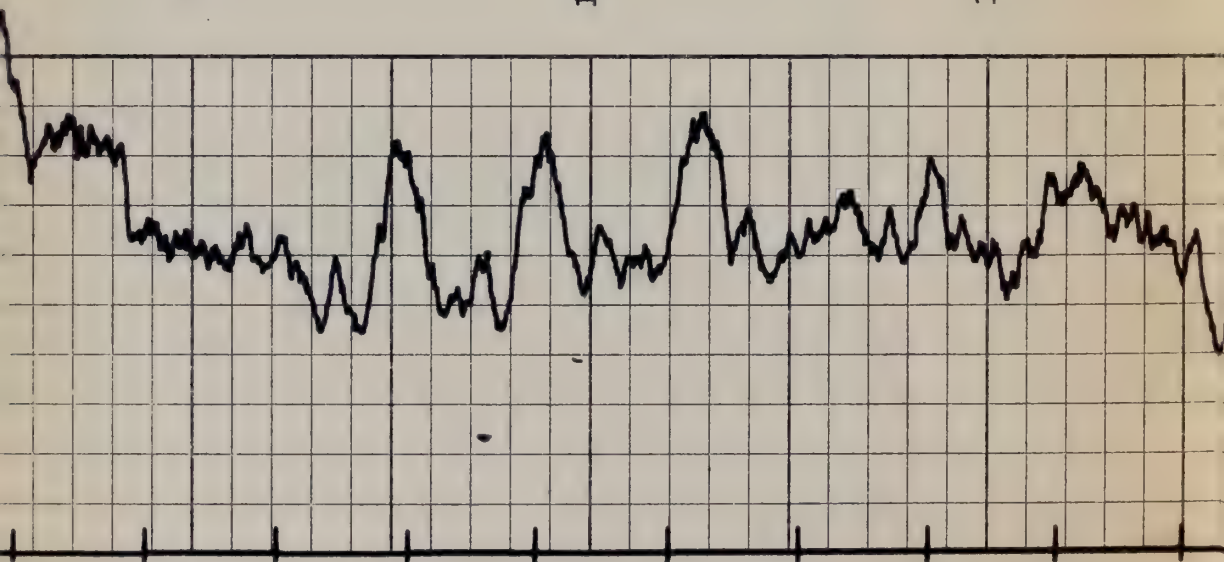


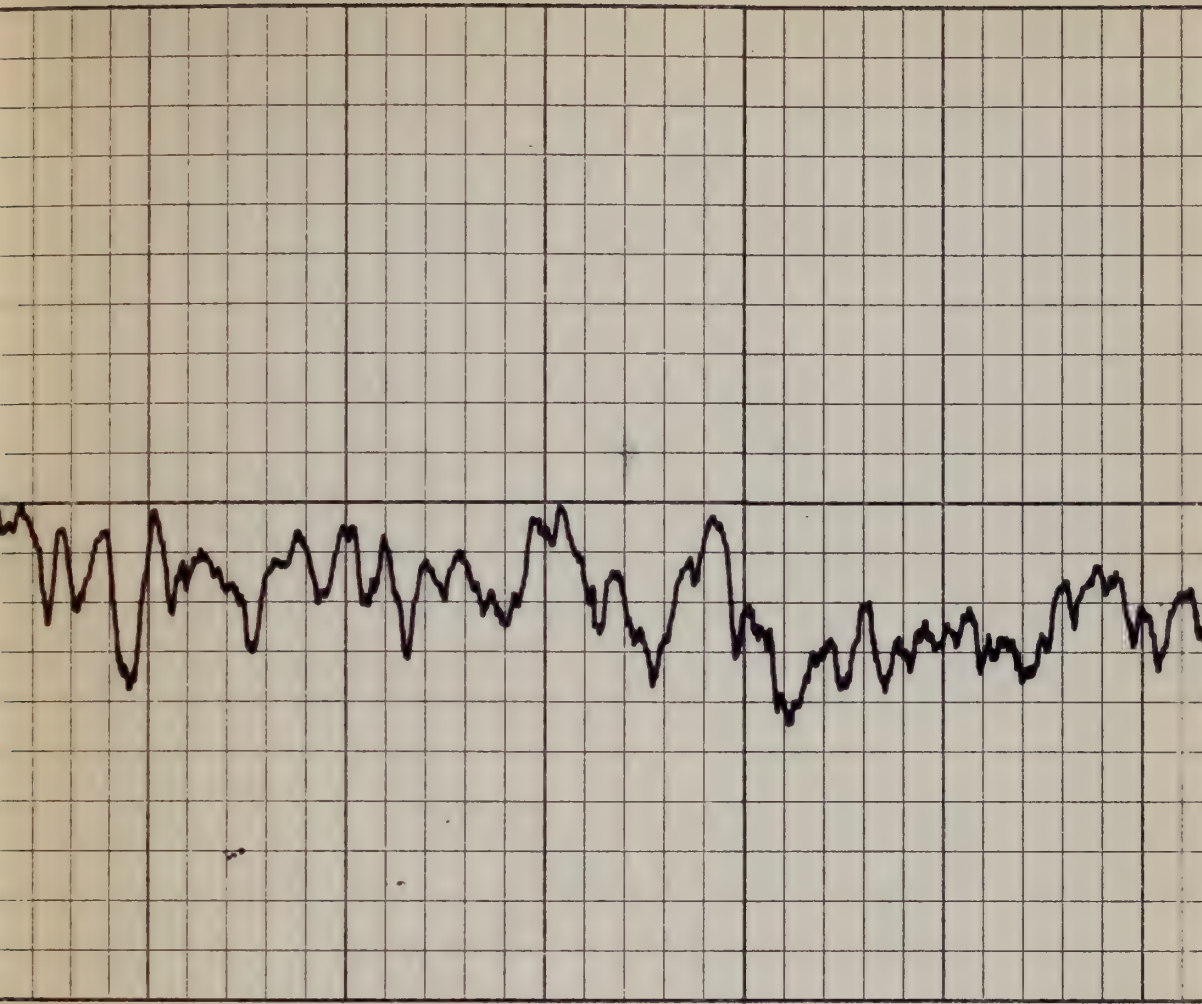


900

1000

1100

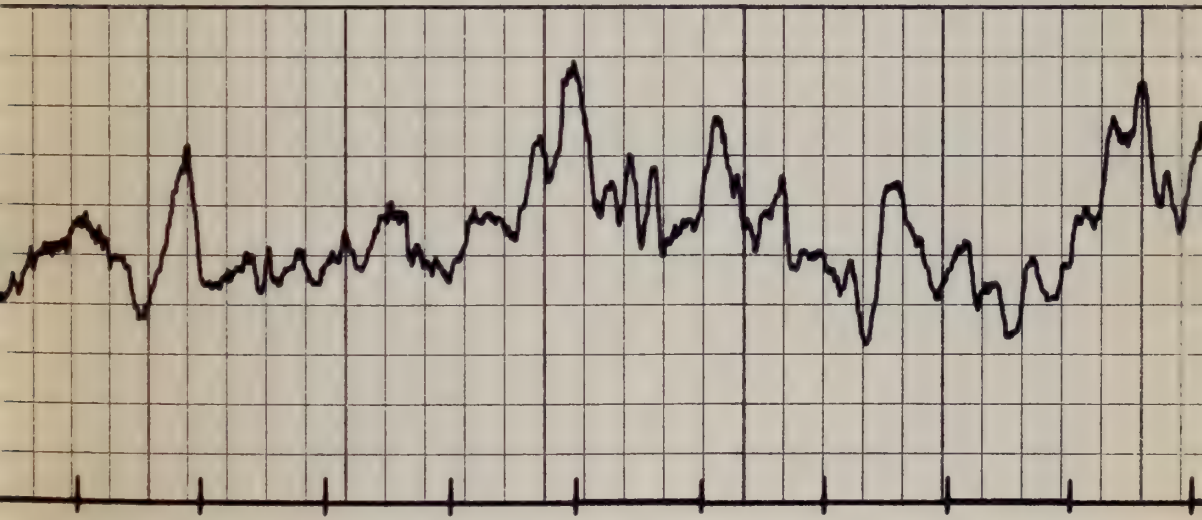


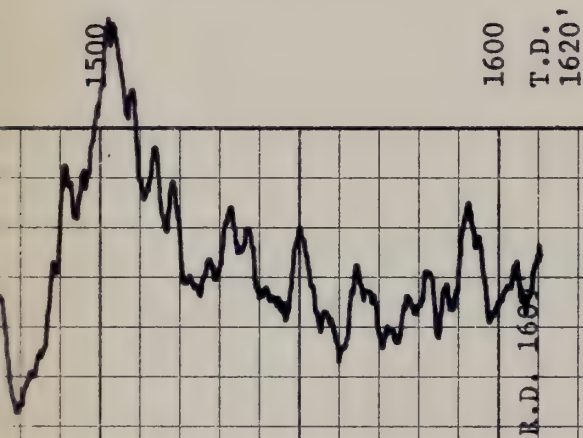
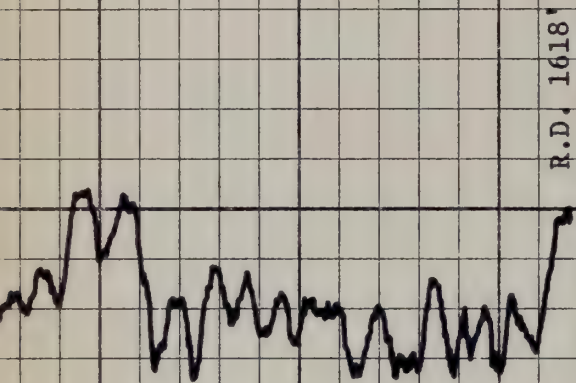


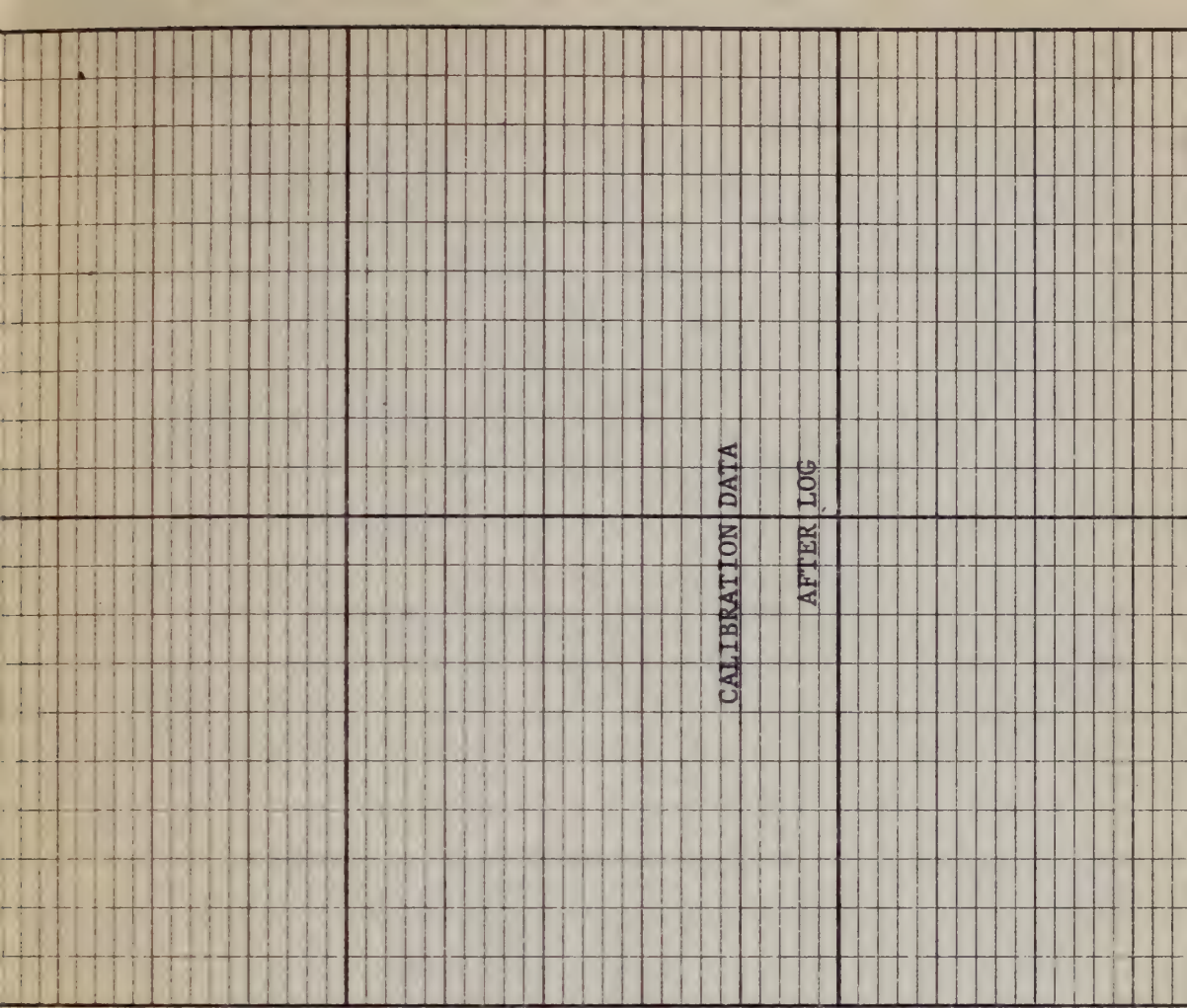
1200

1300

1400

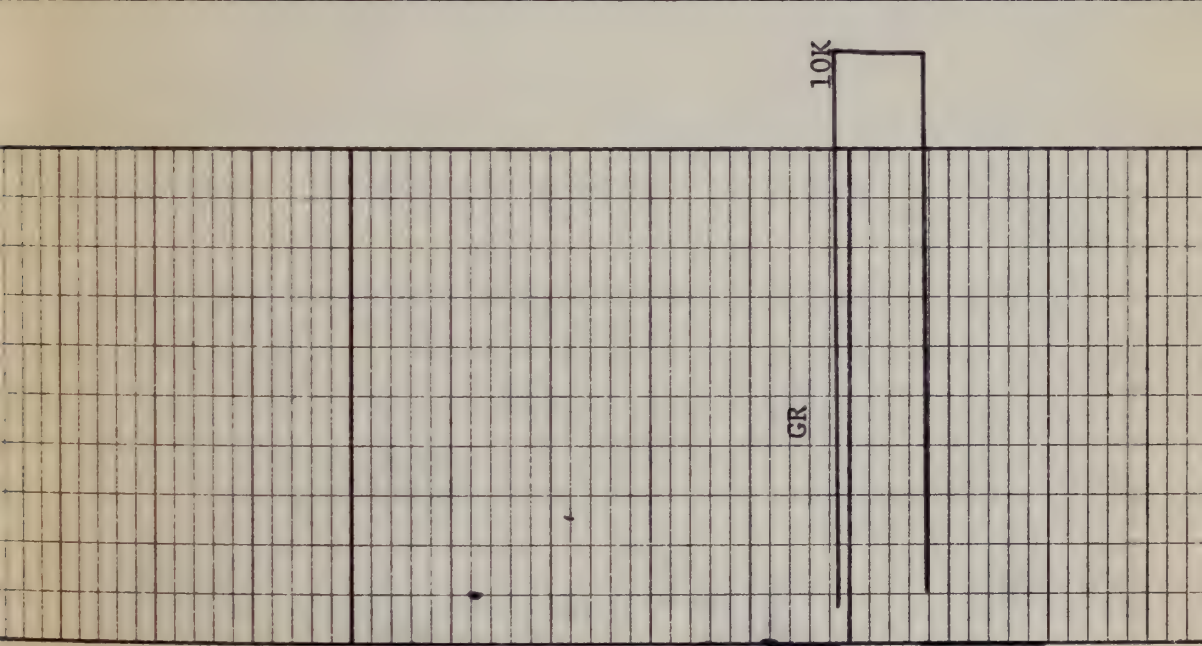






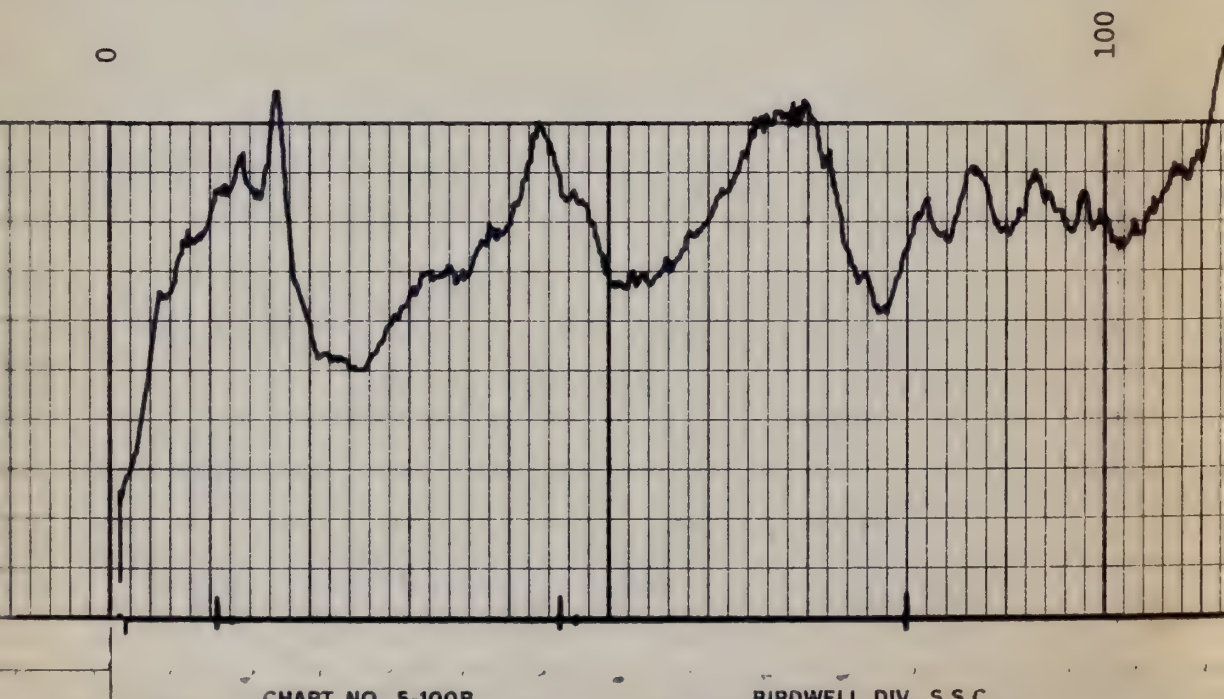
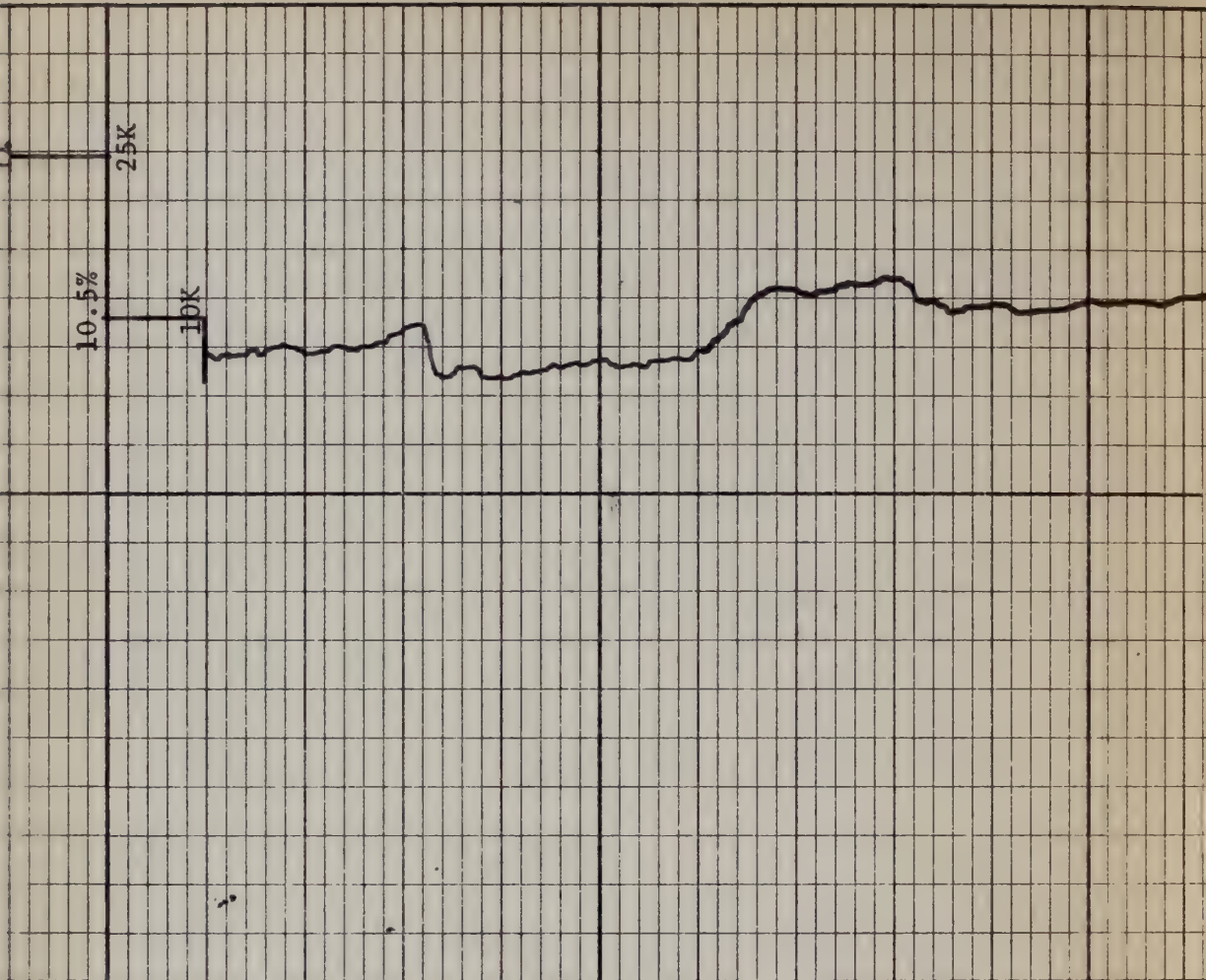
CALIBRATION DATA

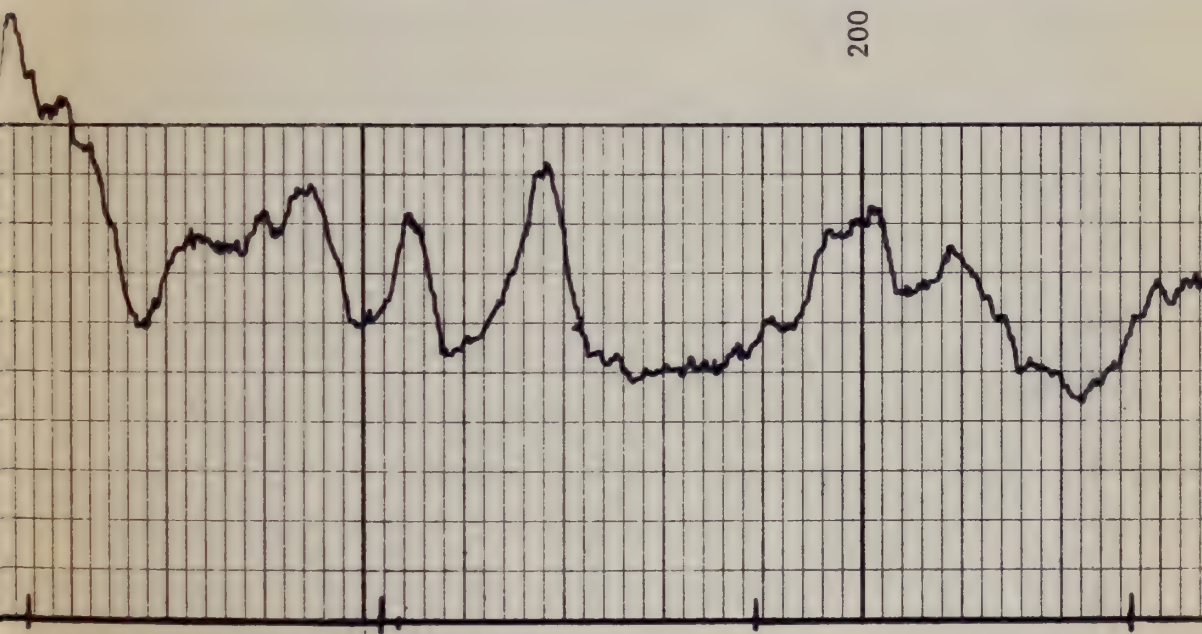
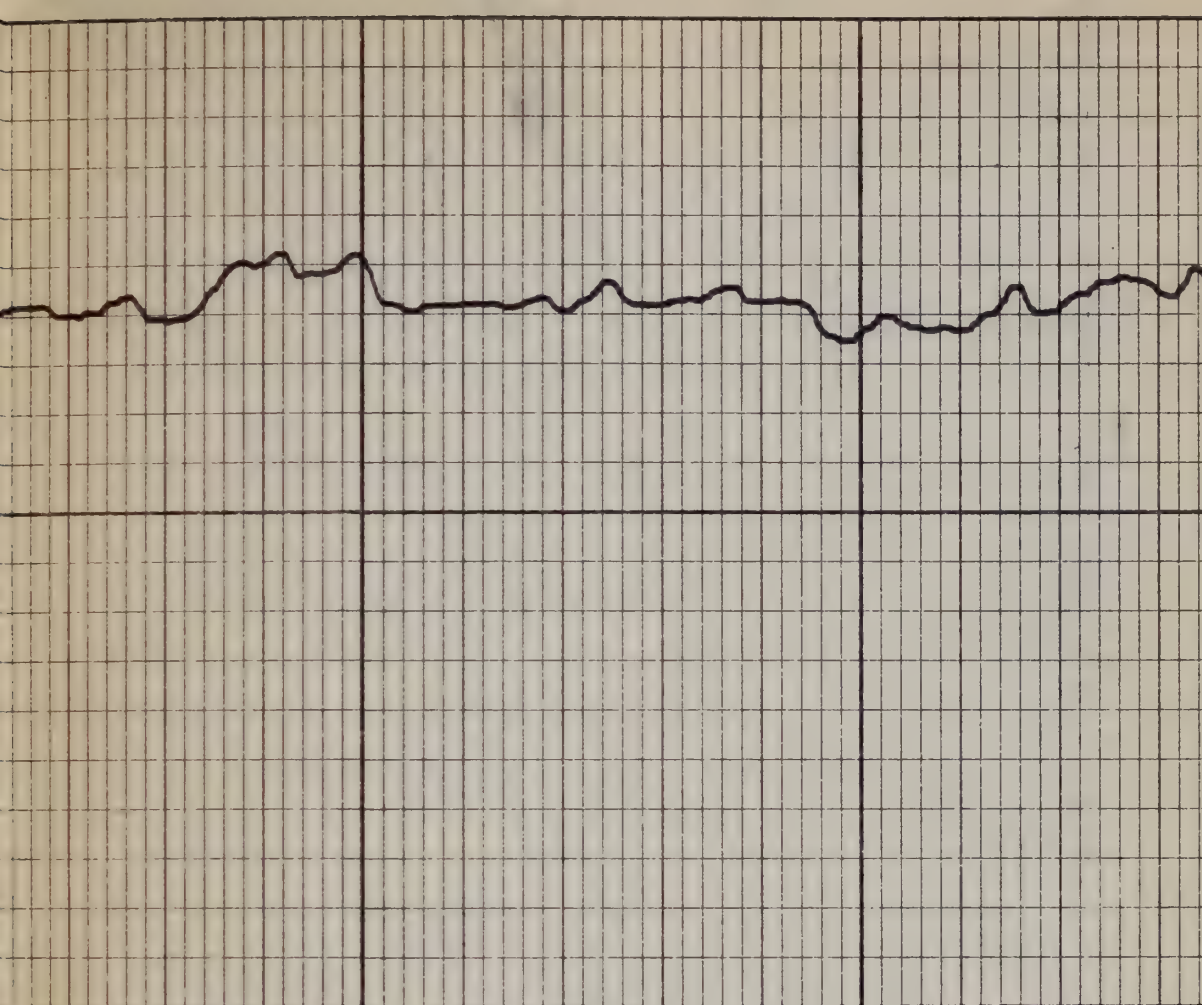
AFTER LOG



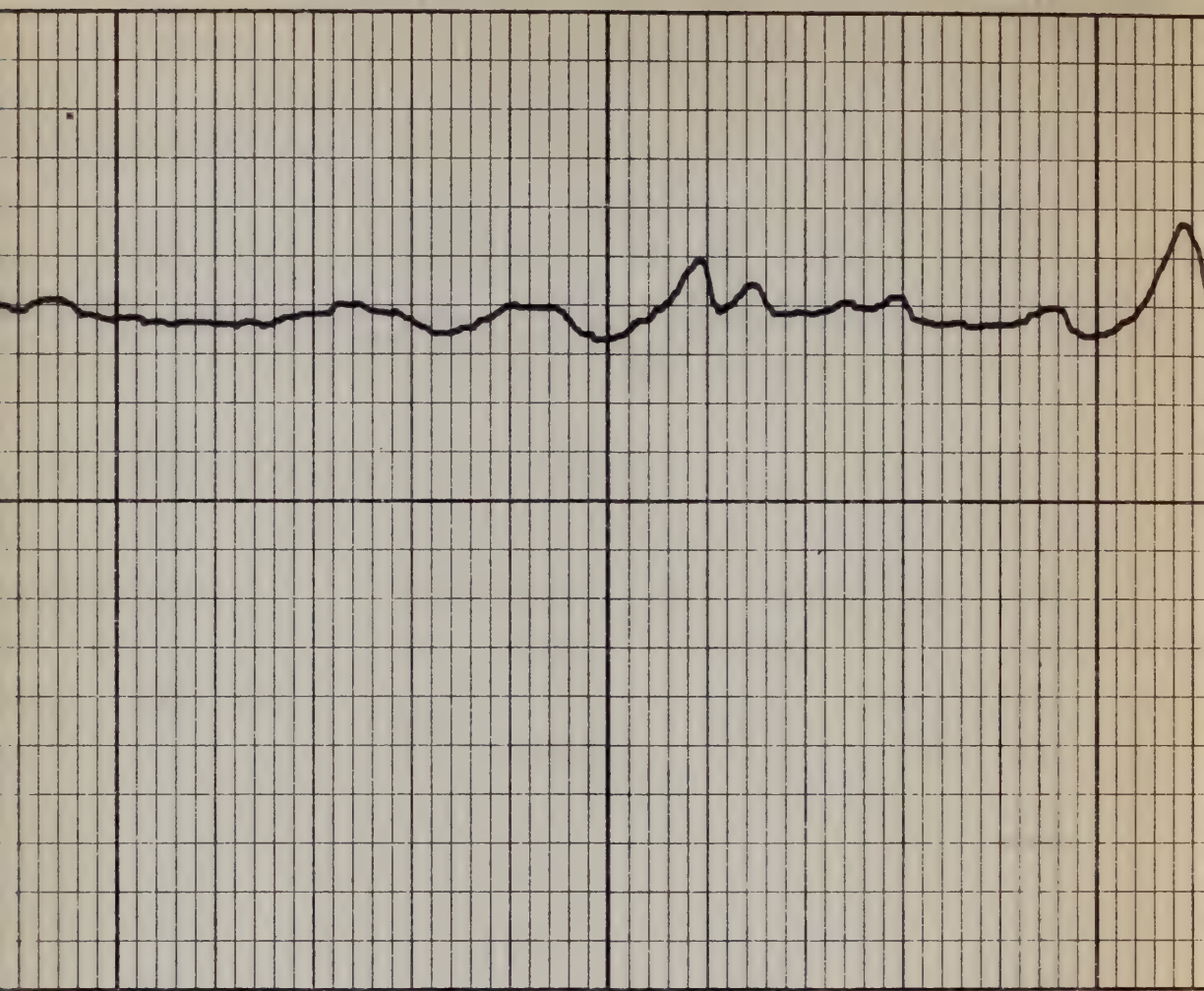
10K

GR

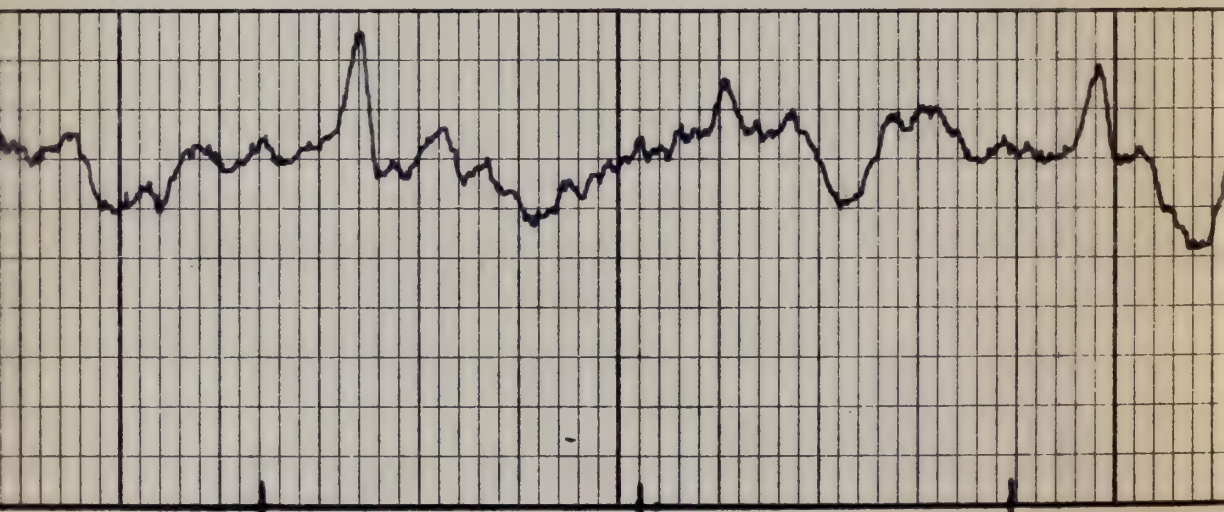


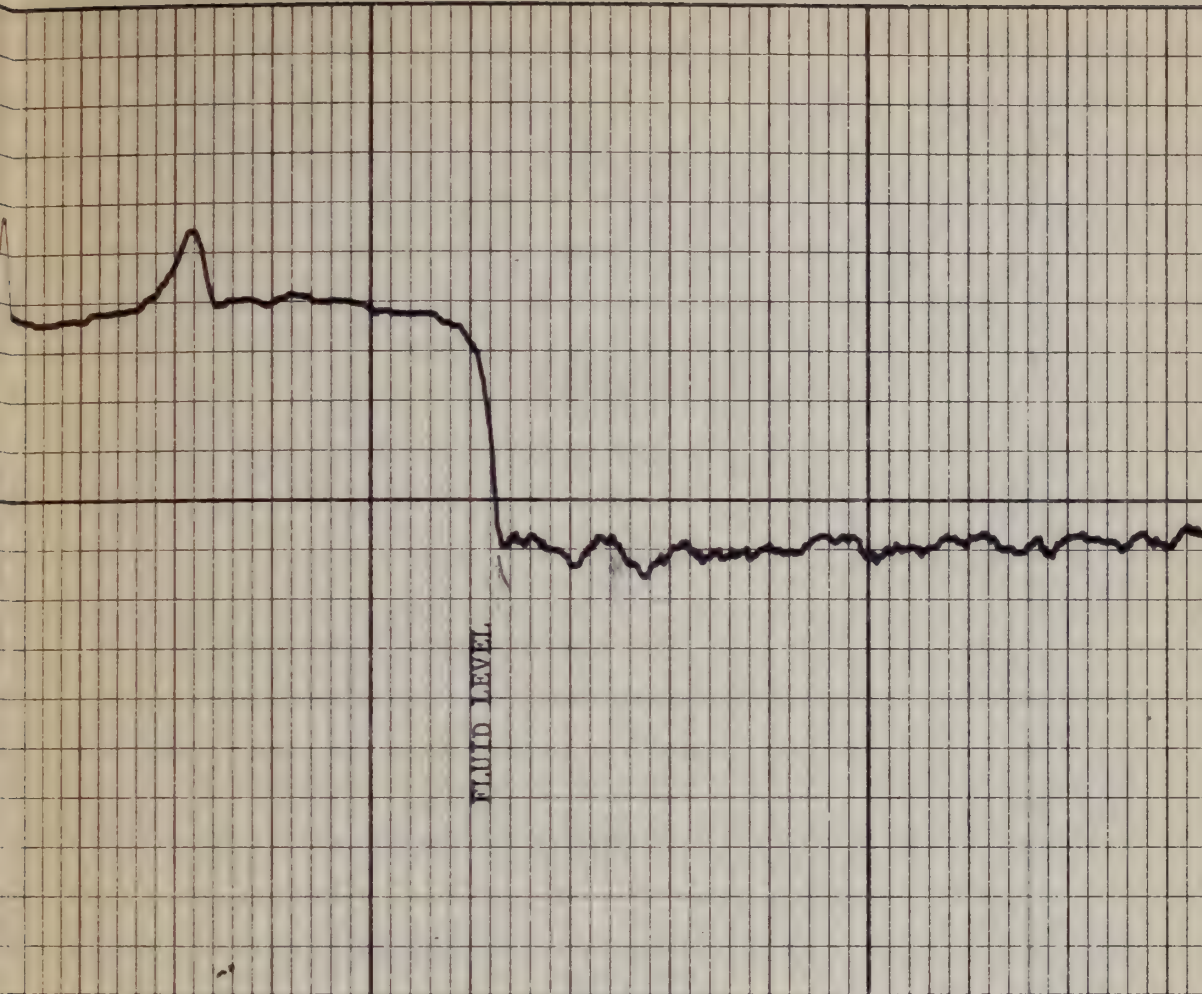


200

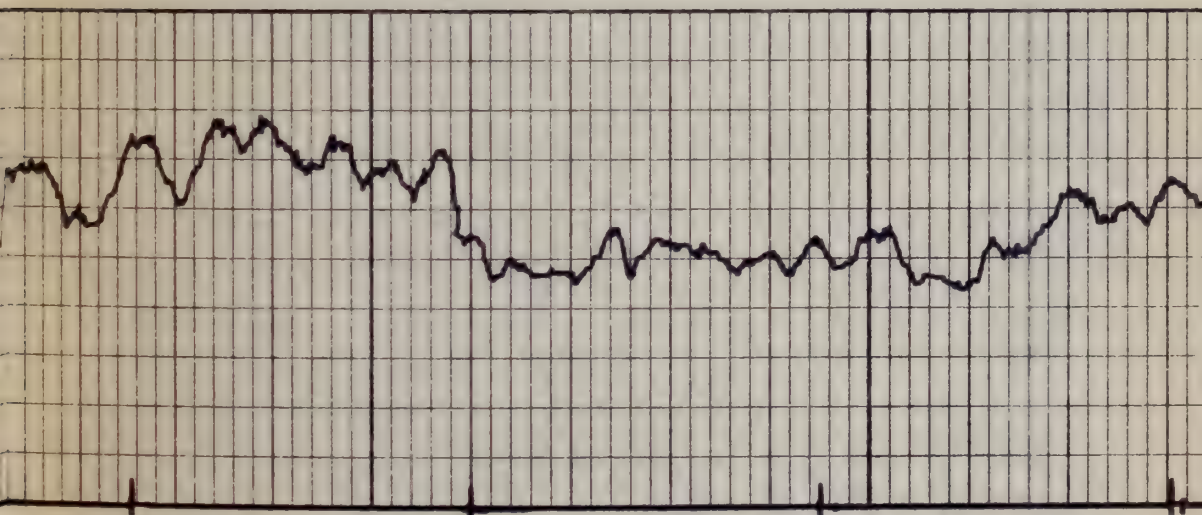


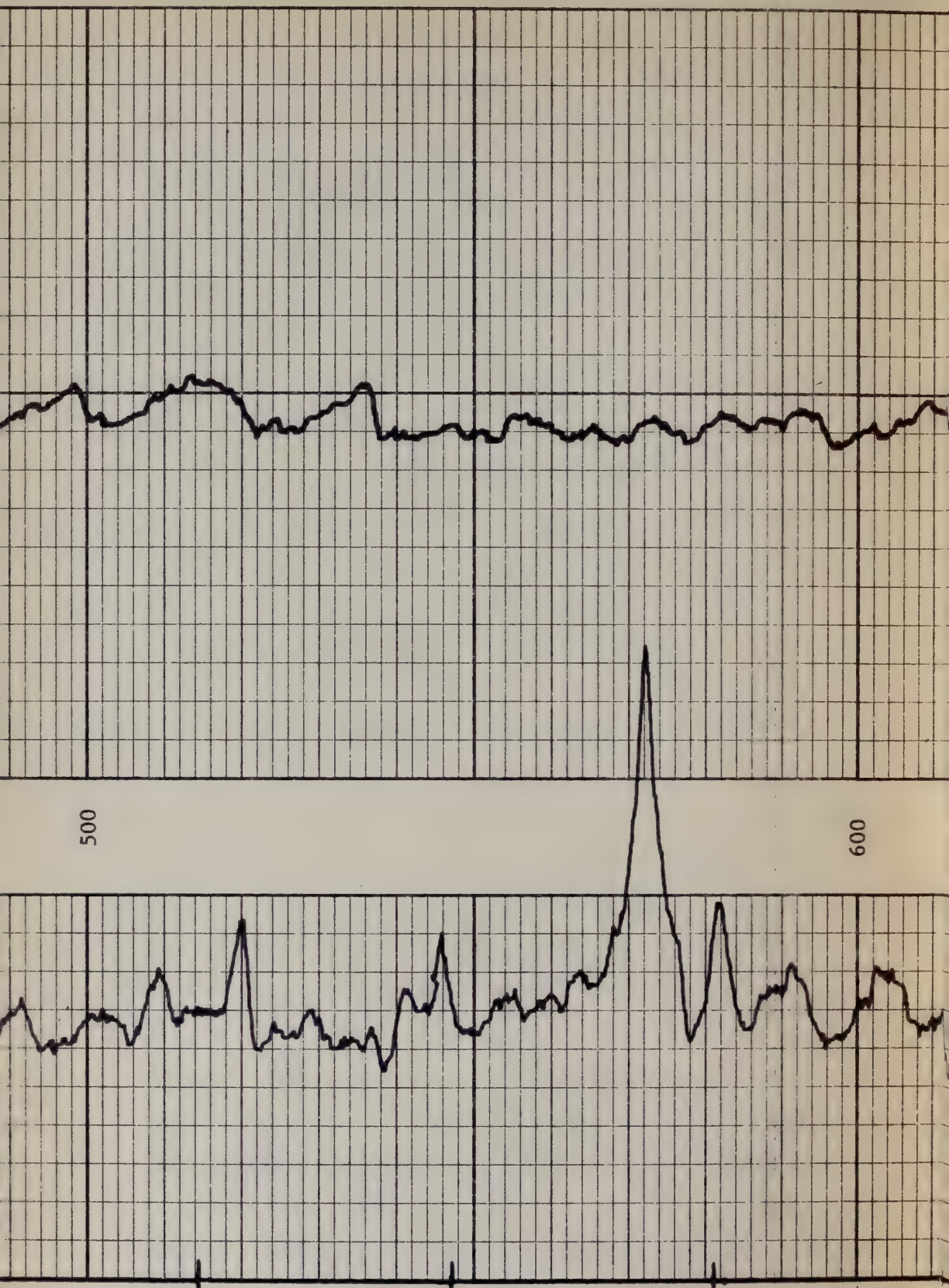
300





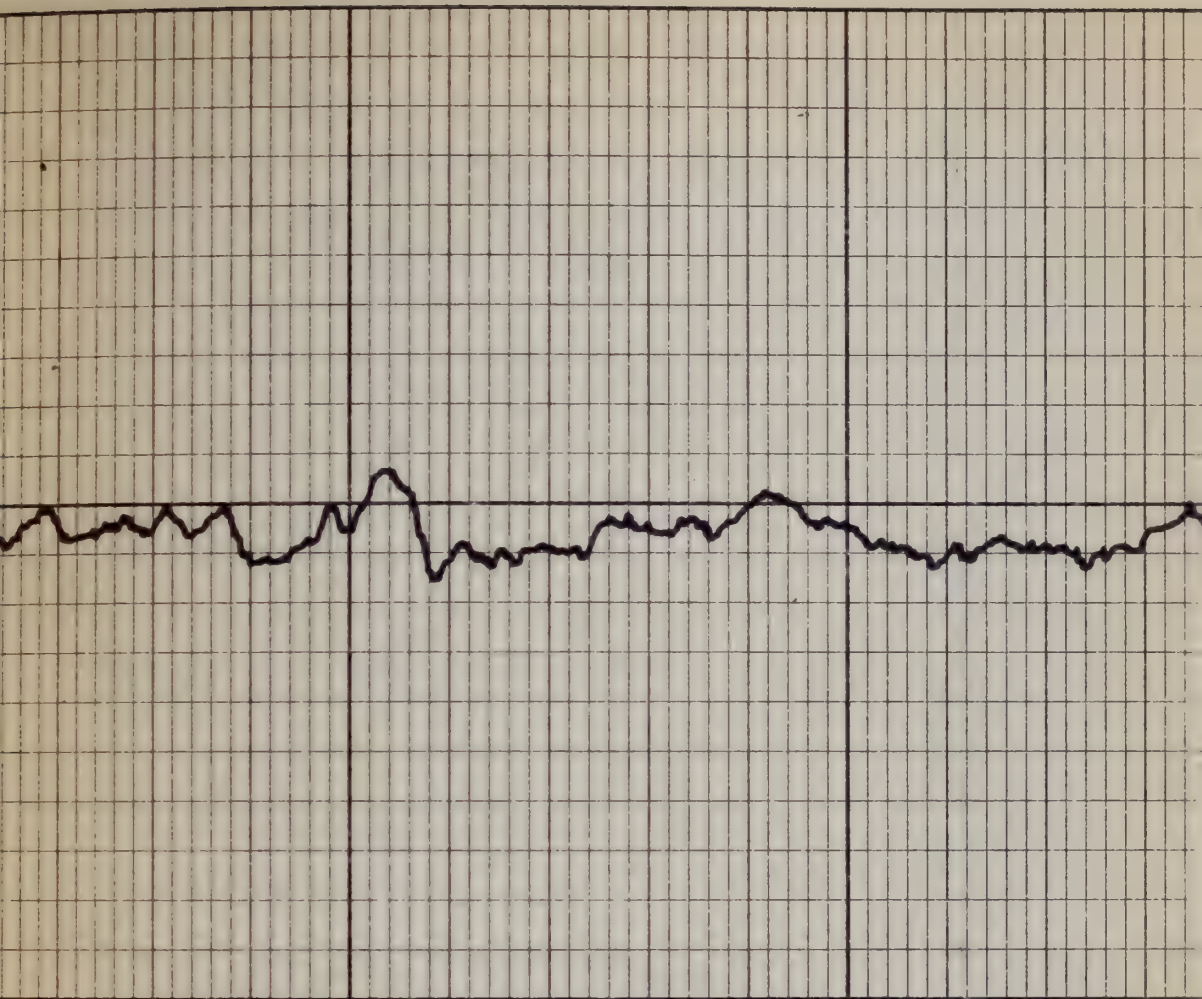
400



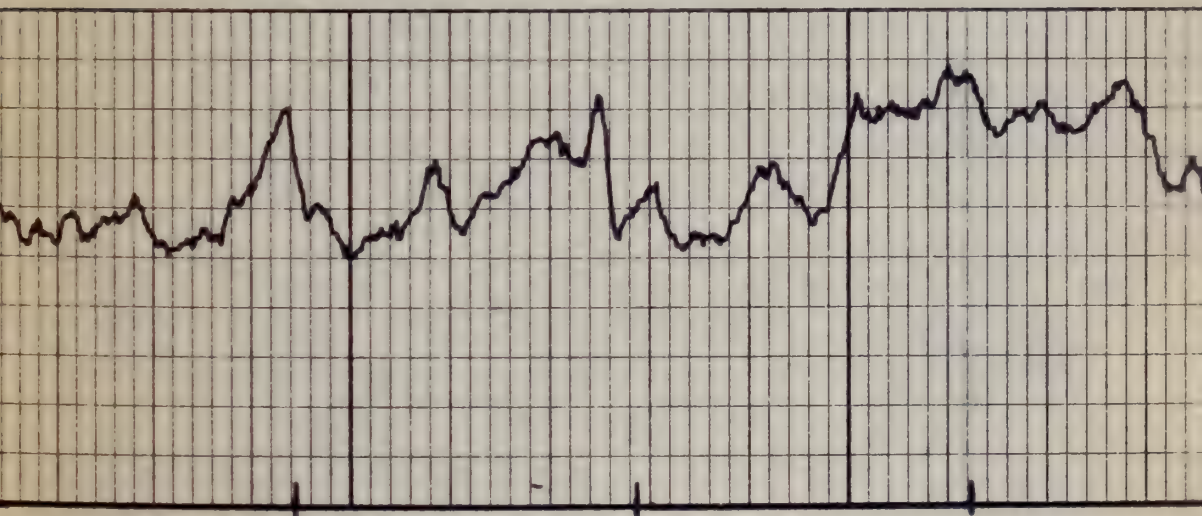


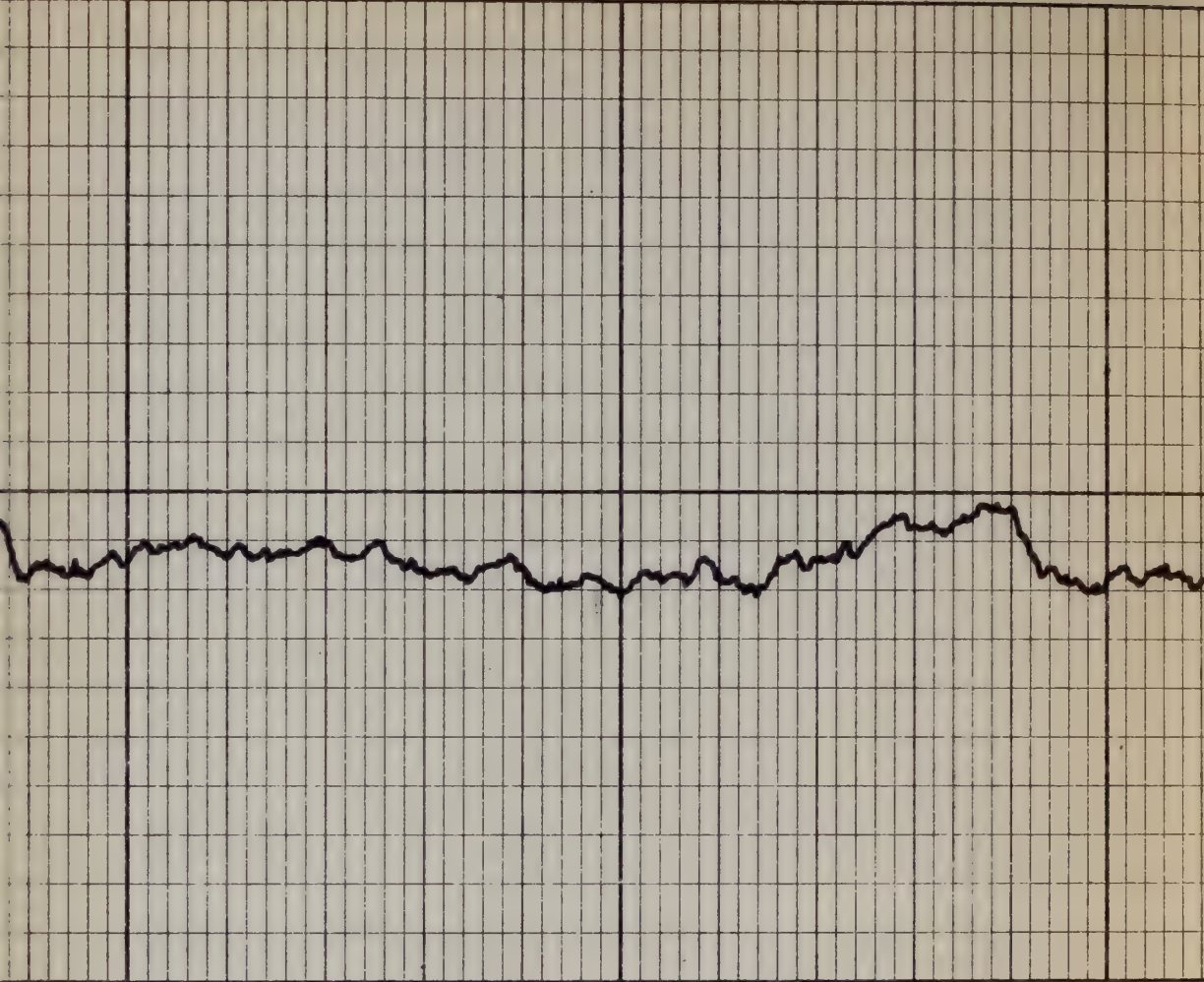
500

600

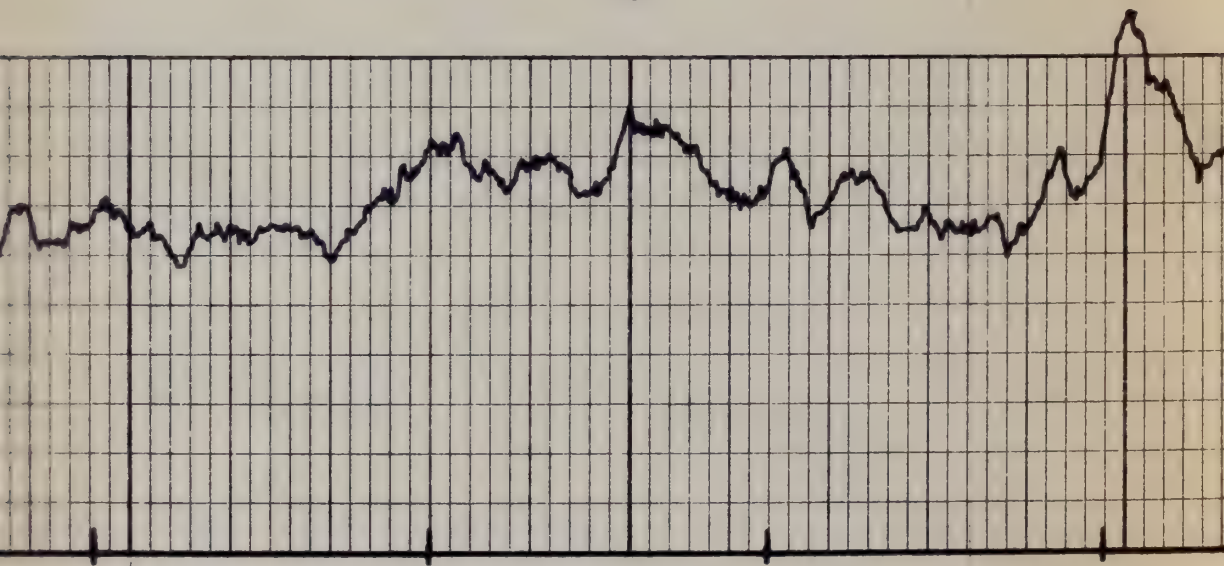


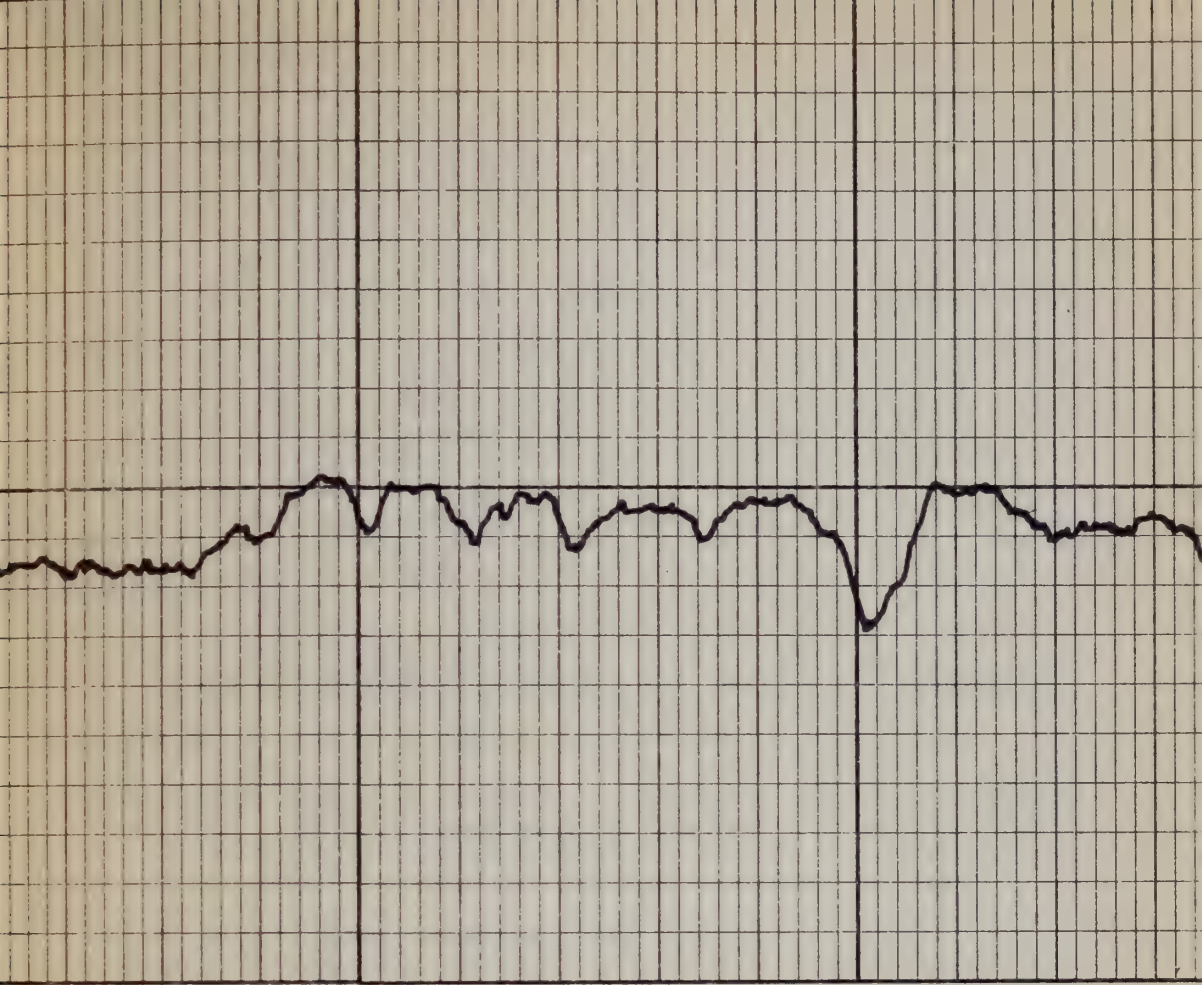
700



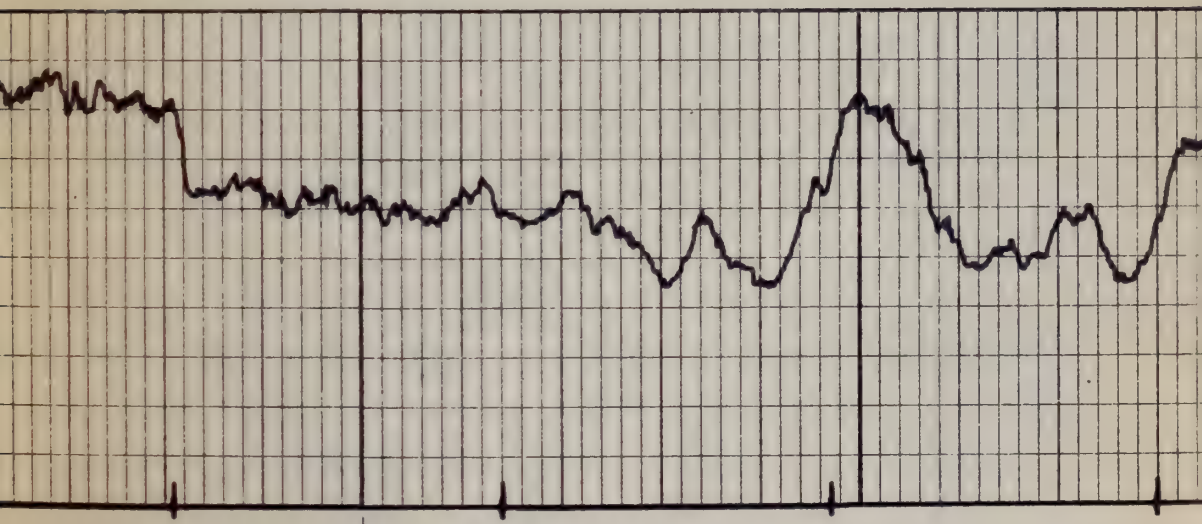


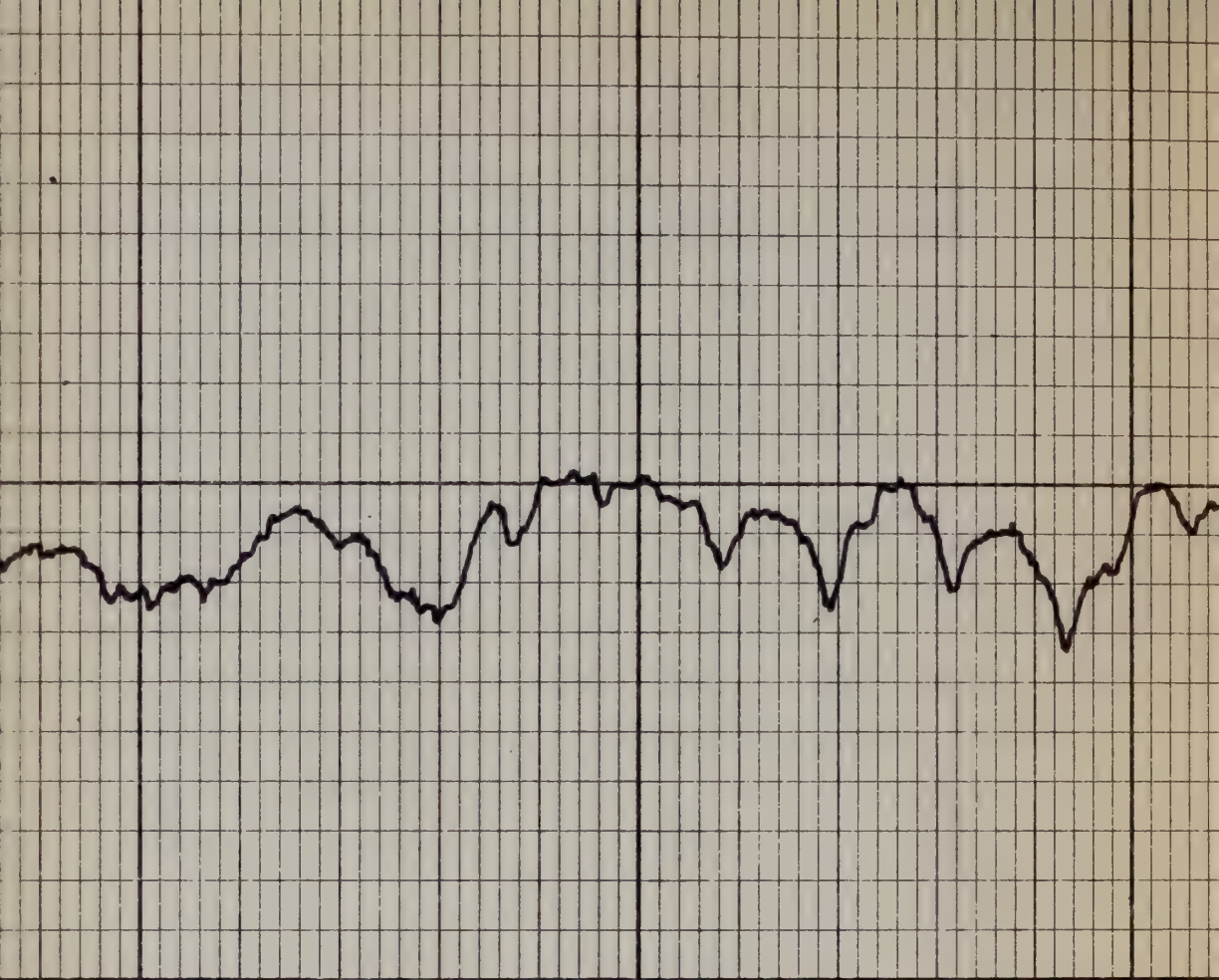
800





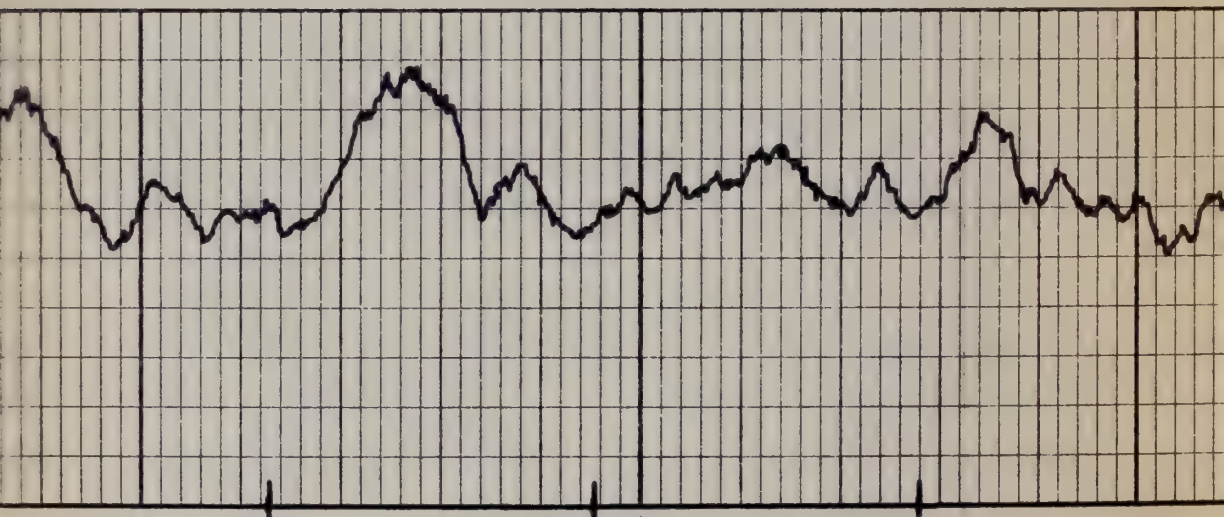
900

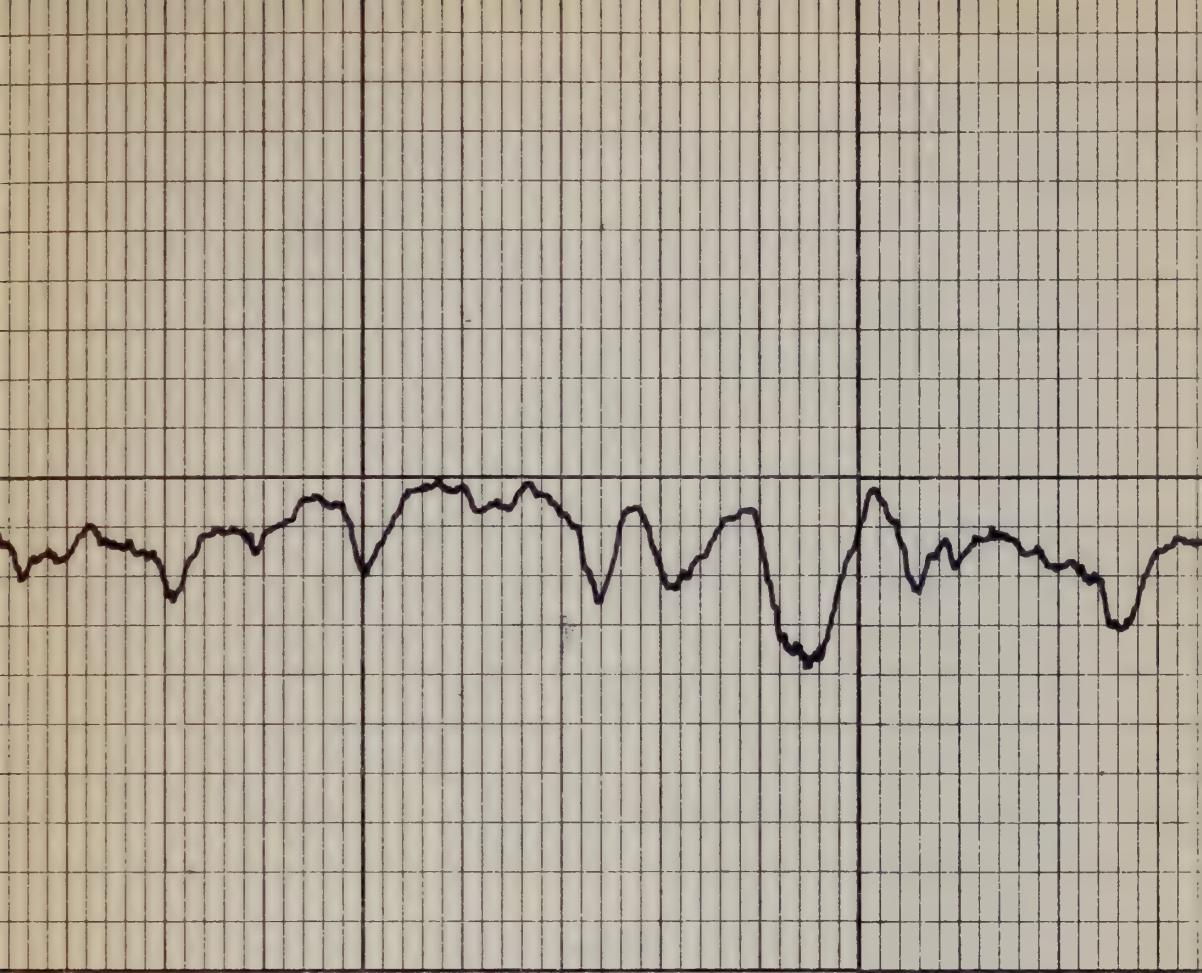




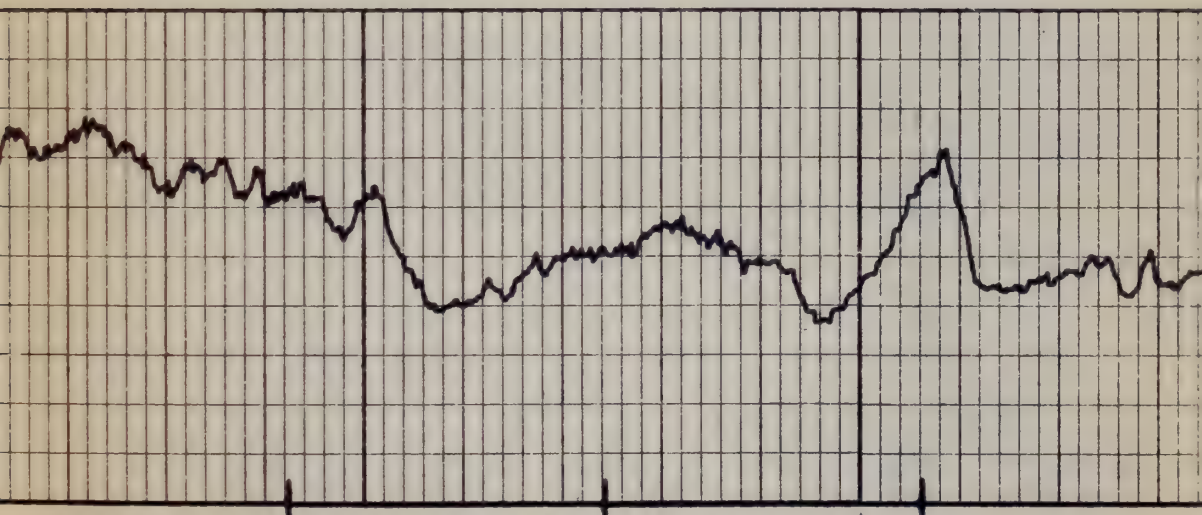
1000

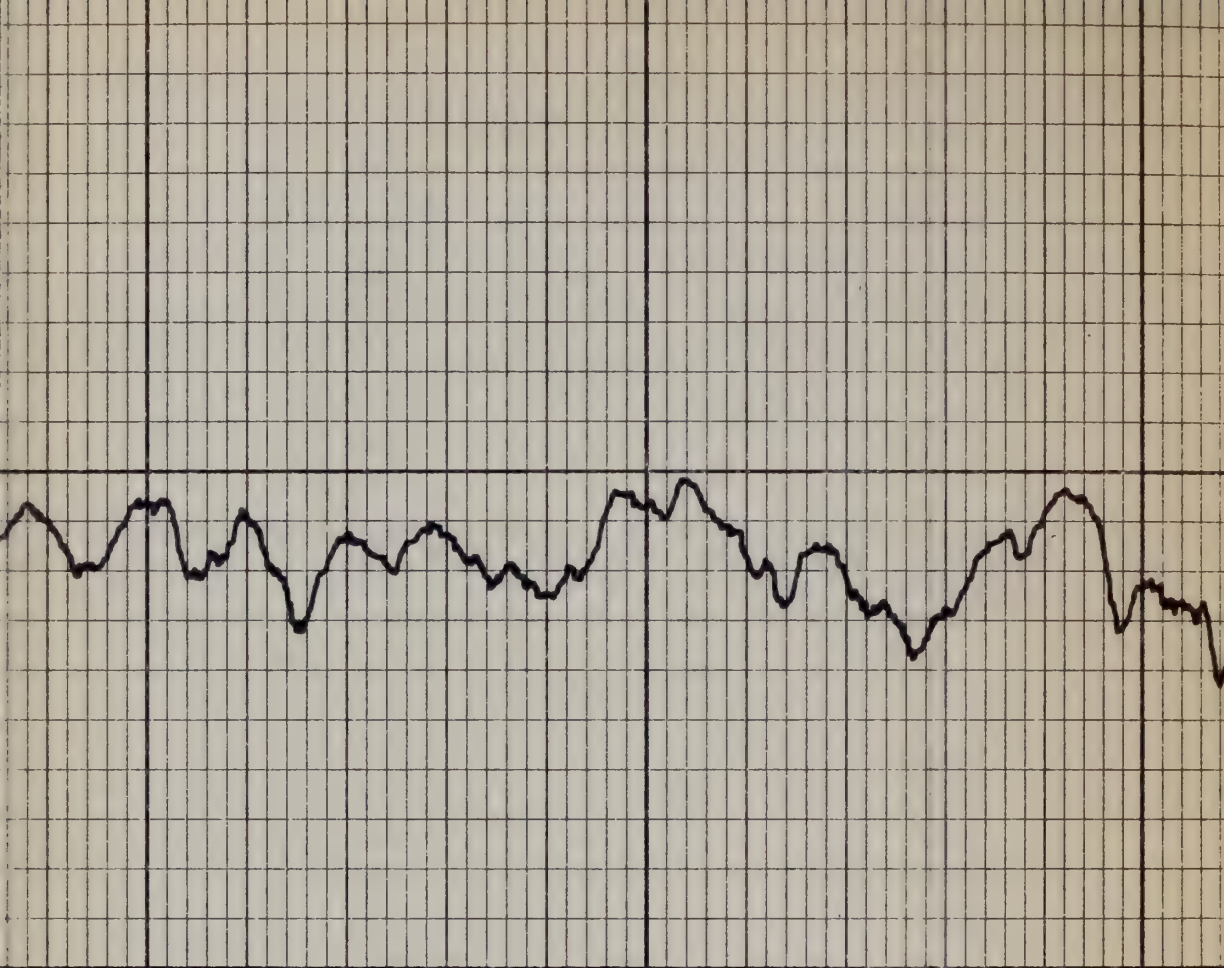
1100



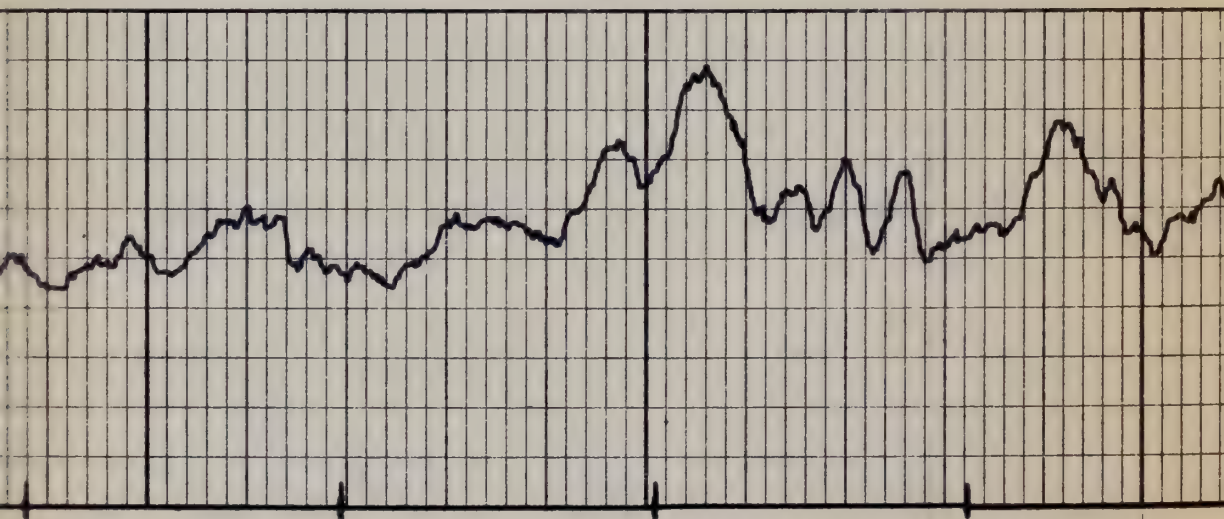


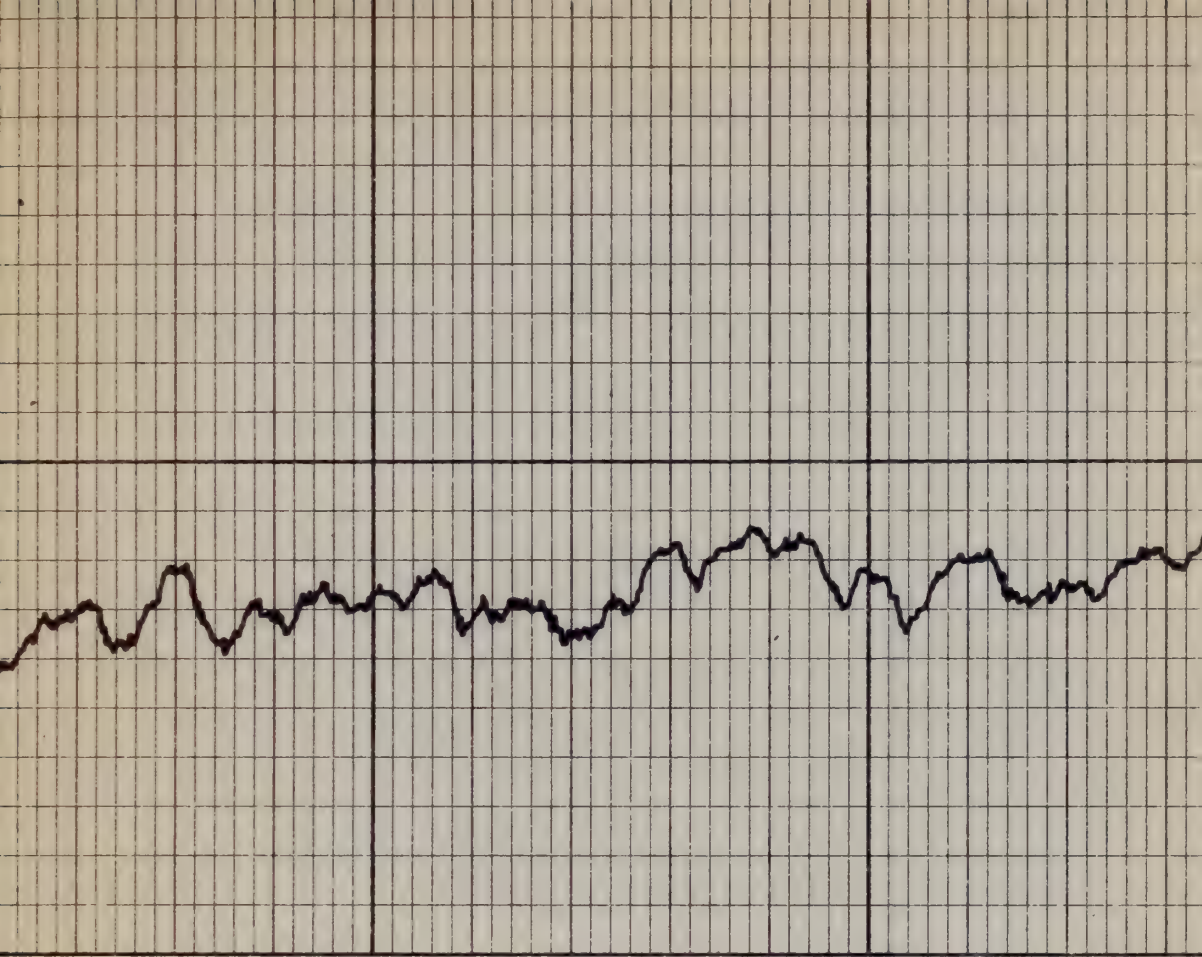
1200



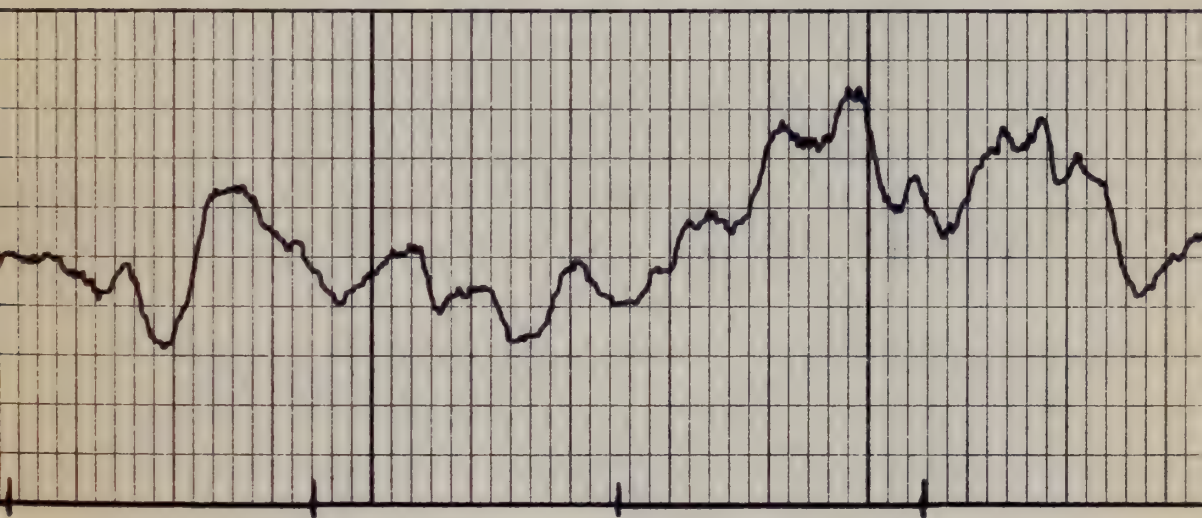


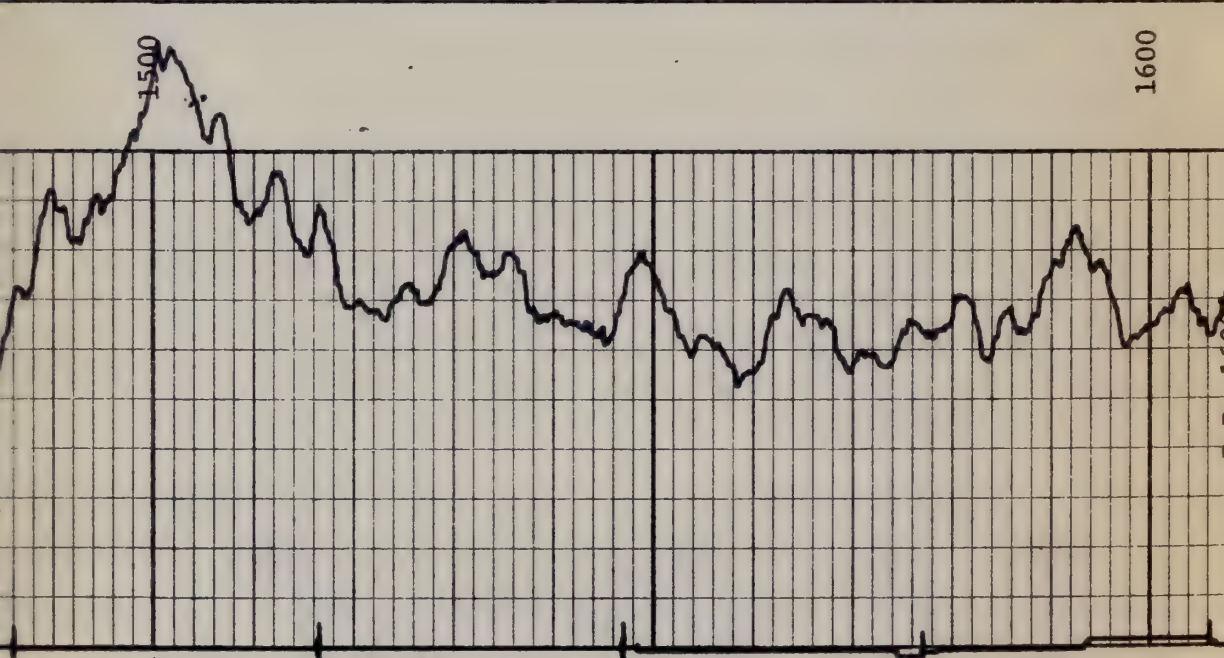
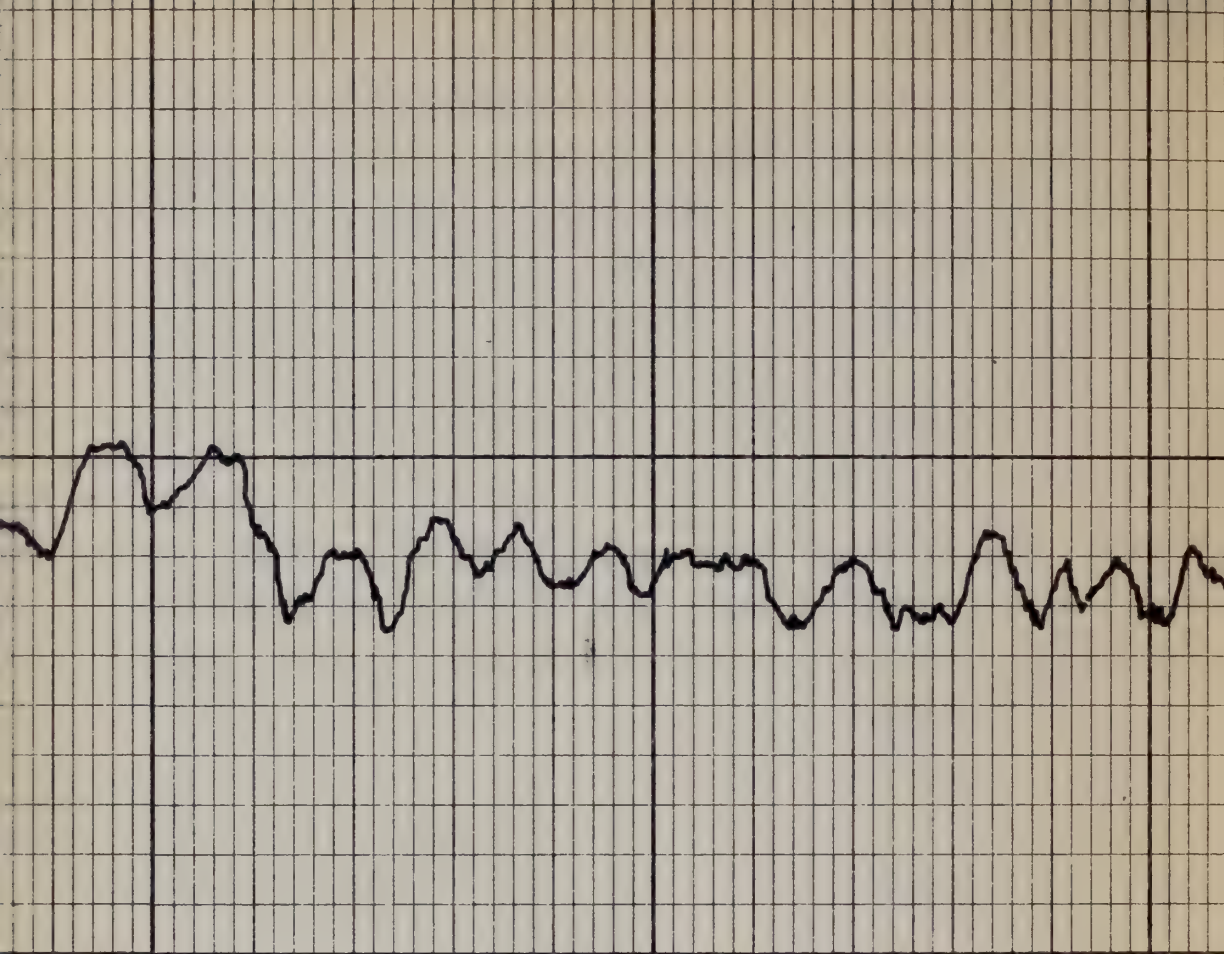
1300





1400





T.D.
1621'

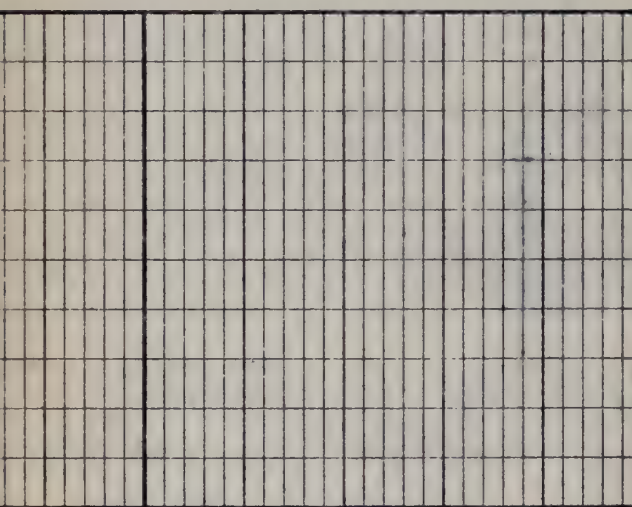
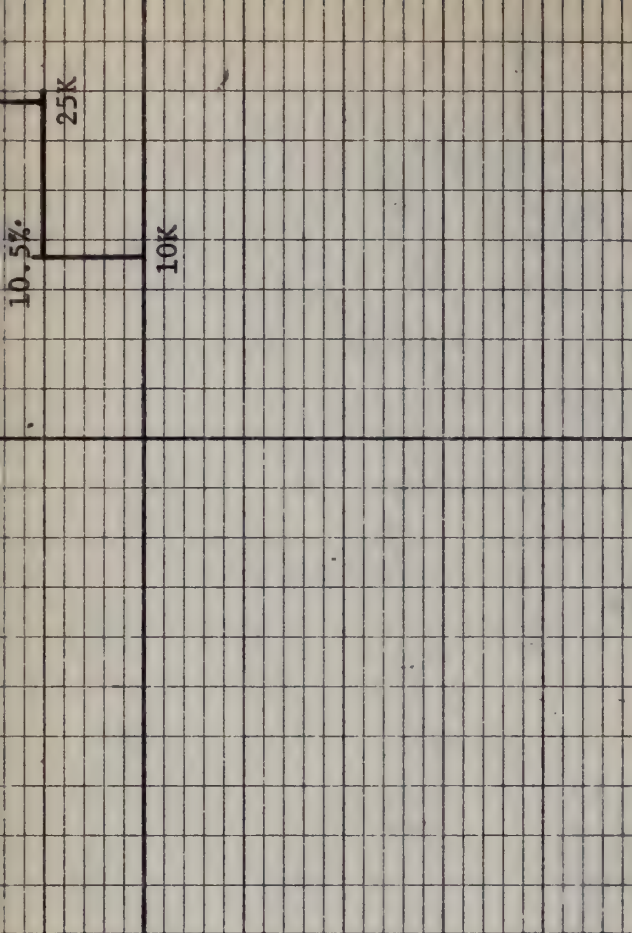
R.D. 1618'

CALIBRATION DATA

BEFORE LOG

GR

10K





Birdwell

Caliper Log

FILING NO.

COMPANY ATLANTIC RICHFIELD COMPANY,

ET. AL.

WELL SORGHUM GULCH AQUIFER TEST #1-A

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

OTHER SERVICES:

GR/ENP TL
V3D FDL ES

SEC. 7 TWP. 3S RGE. 96W

ELEVATIONS:

PERMANENT DATUM GROUND LEVEL ELEV. 6909'

LOG MEASURED FROM GL

KB.

DRILLING MEASURED FROM GL

DF.

GL. 6909'

DATE	2 JULY 74
RUN NO.	1
TYPE LOG	CAL
DEPTH-DRILLER	1621
DEPTH-LOGGER	1620
BOTTOM LOGGED INTERVAL	1618
TOP LOGGED INTERVAL	10
TYPE FLUID IN HOLE	WATER
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	412
MAX. REC. TEMP.-DEG. F.	78°
OPR. RIG TIME	1/2 HR.
RECORDED BY	WILSON
WITNESSED BY	TAIT
LOCATION	LAS VEGAS

RUN NO.	BORE HOLE RECORD			CASING RECORD			
	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	6-1/4"	62'	1621'	7"		0	62'

.....

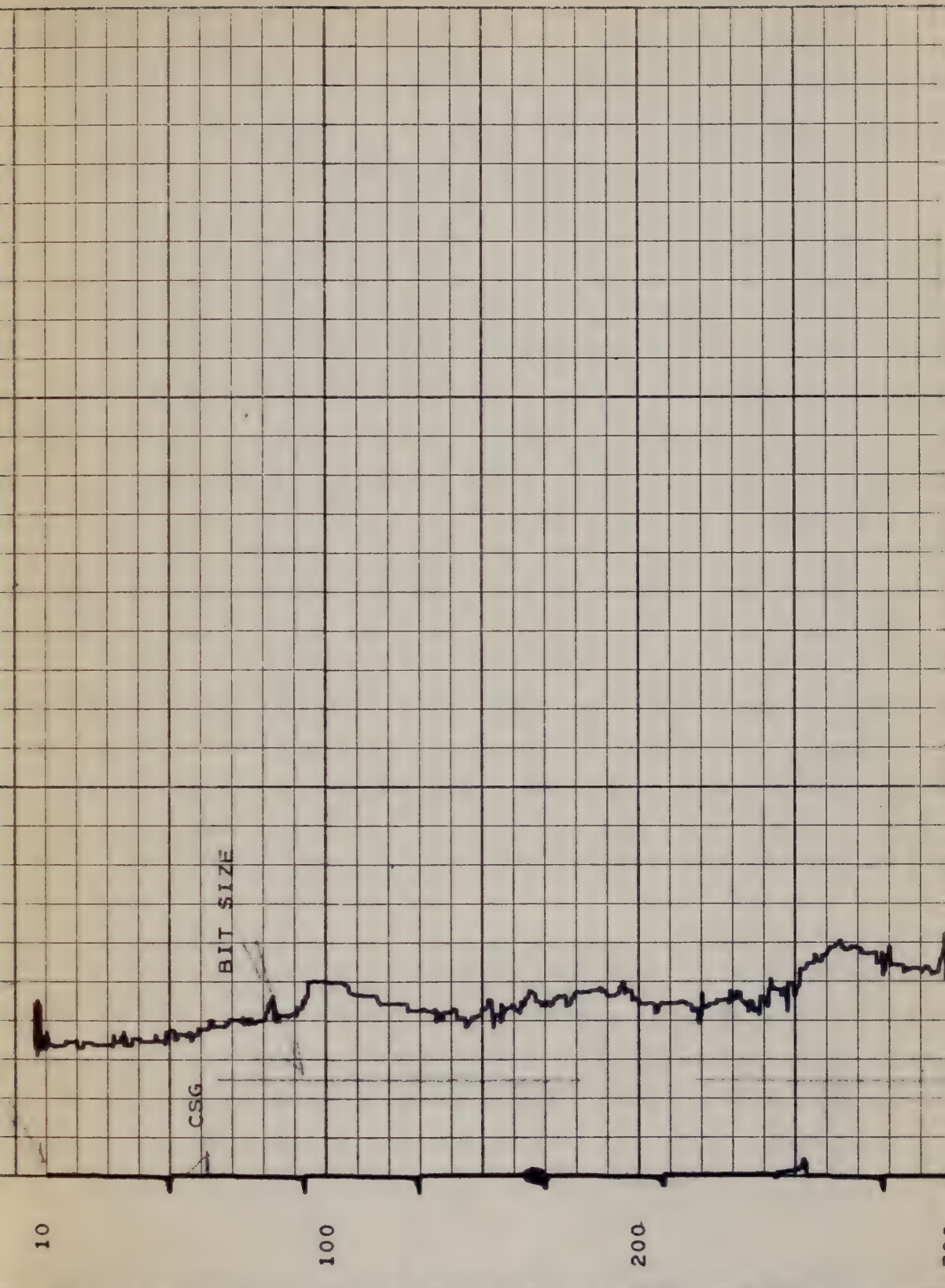
HOLE DIAMETER IN INCHES

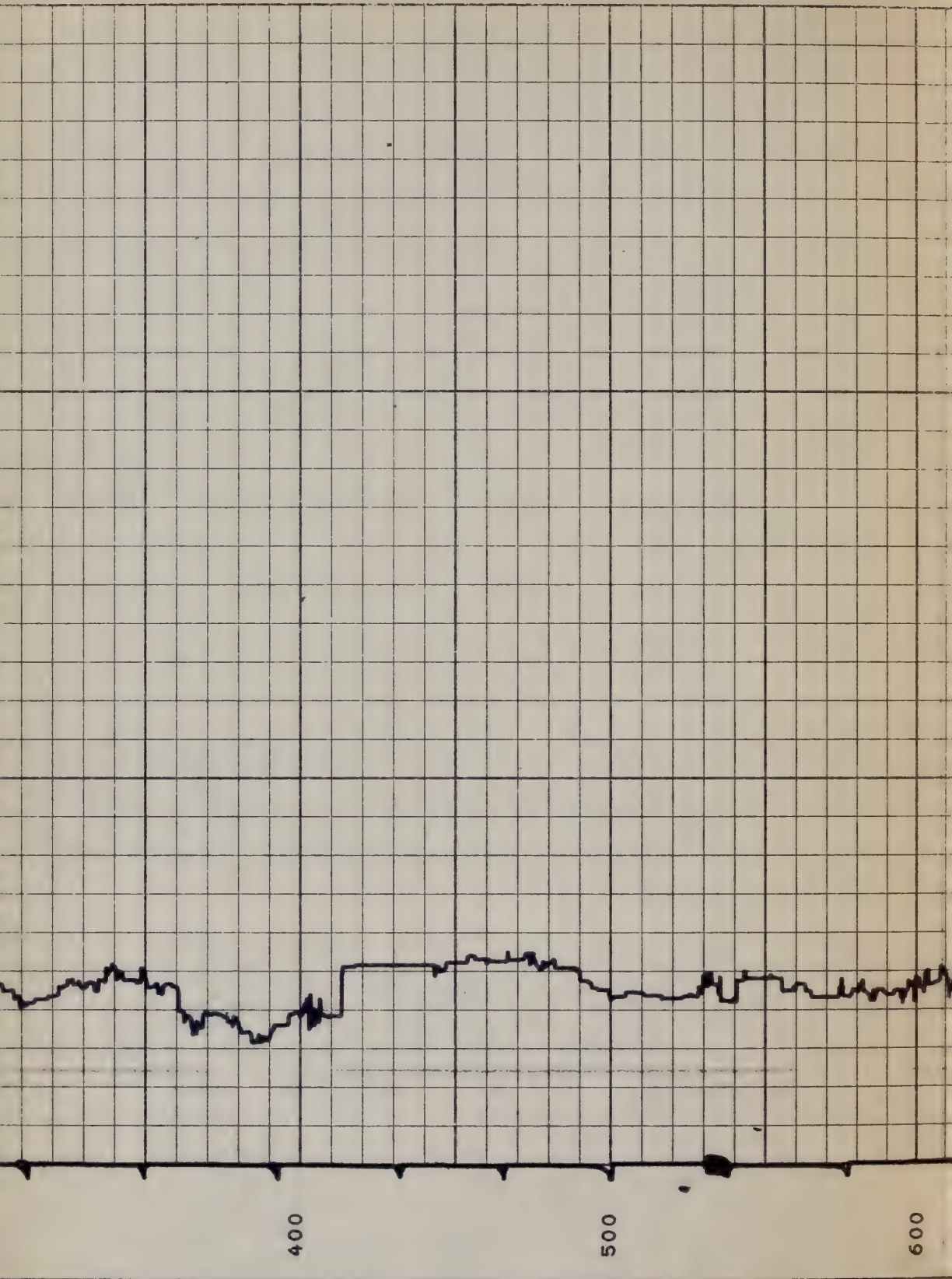
10

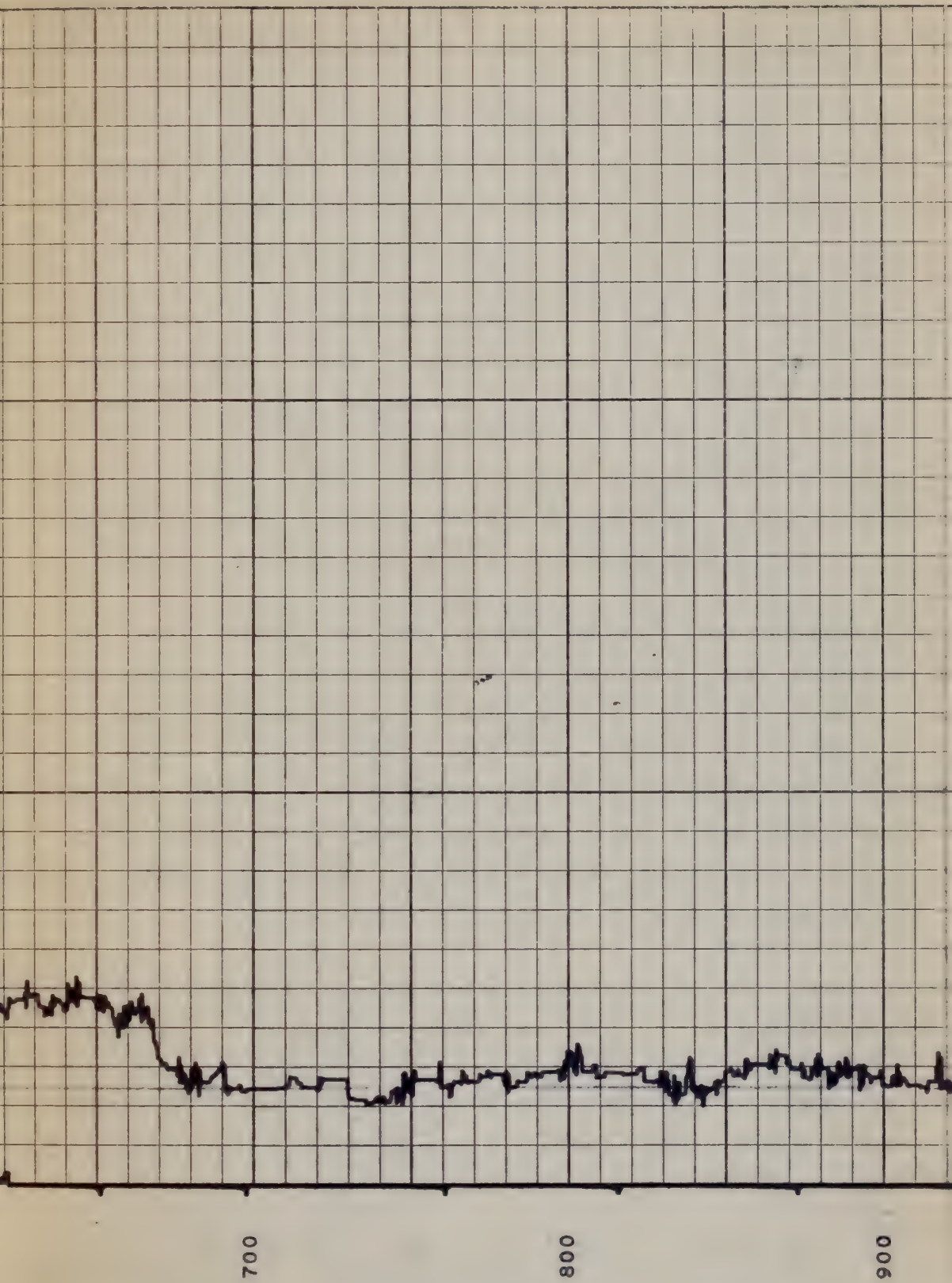
151

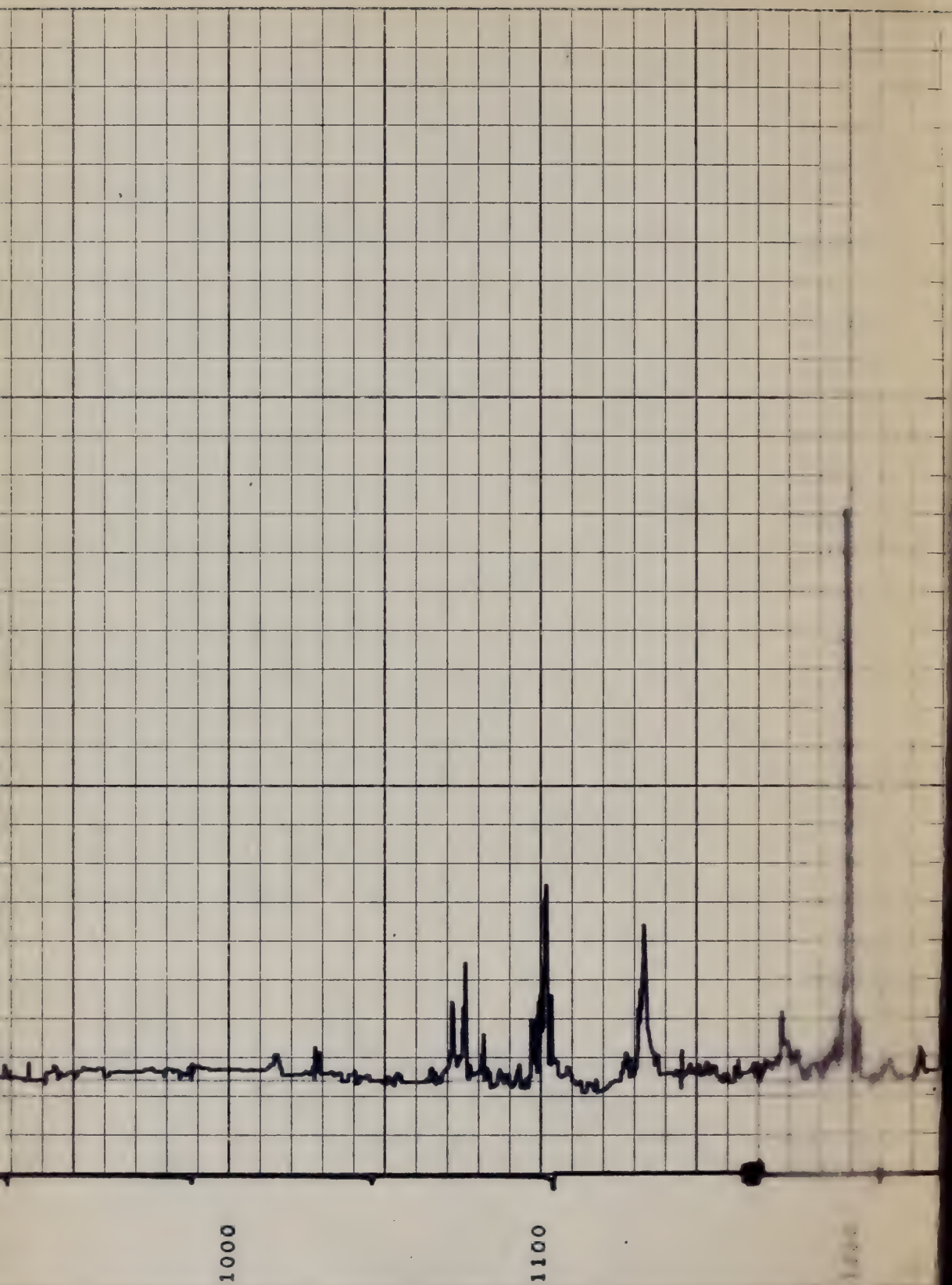
०३

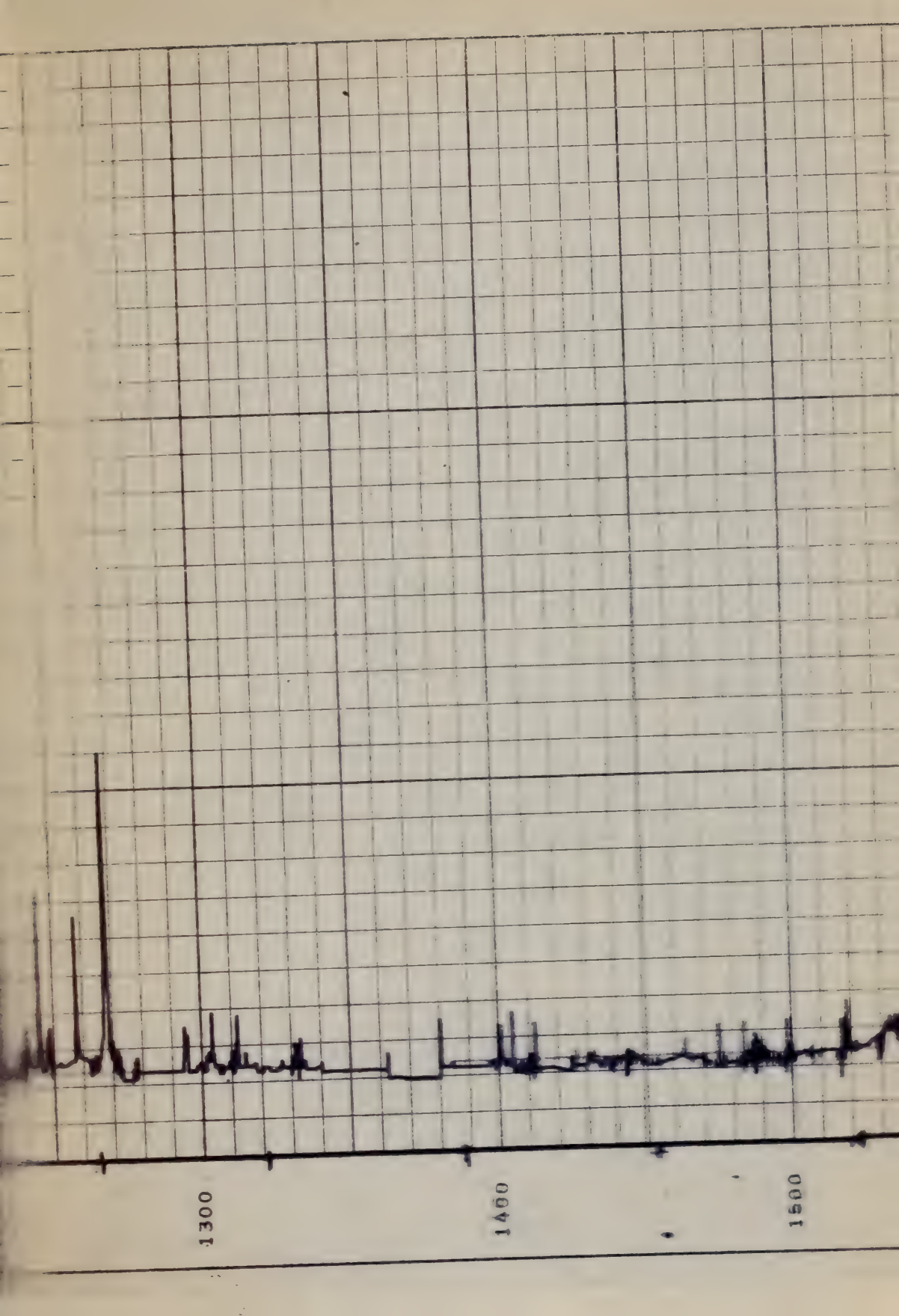
INTEGRATED HOLE VOLUME
10 CUBIC CM





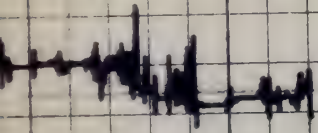






1600
T.D.
1620'

R.D. 1618'

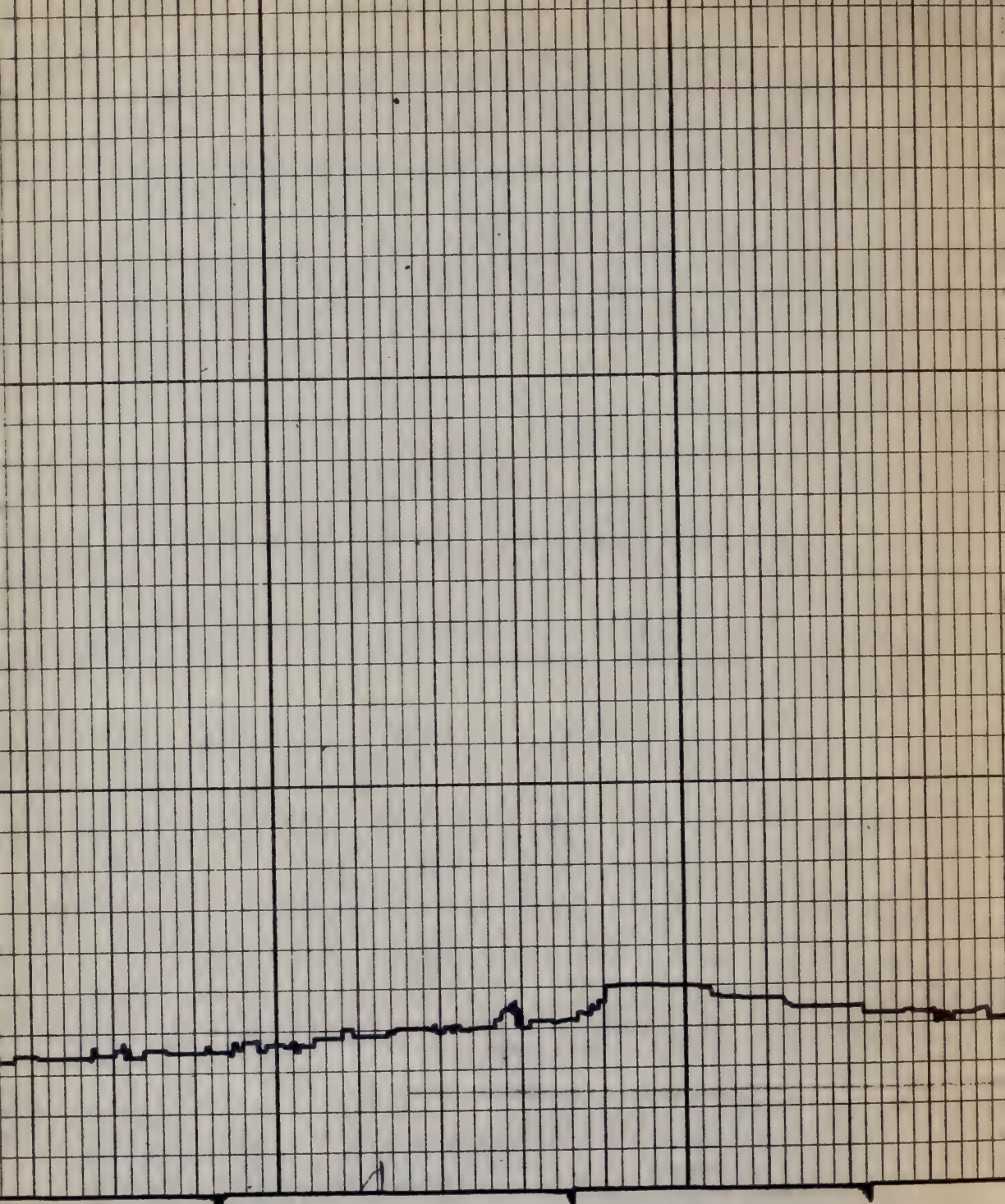


CALIBRATION DATA

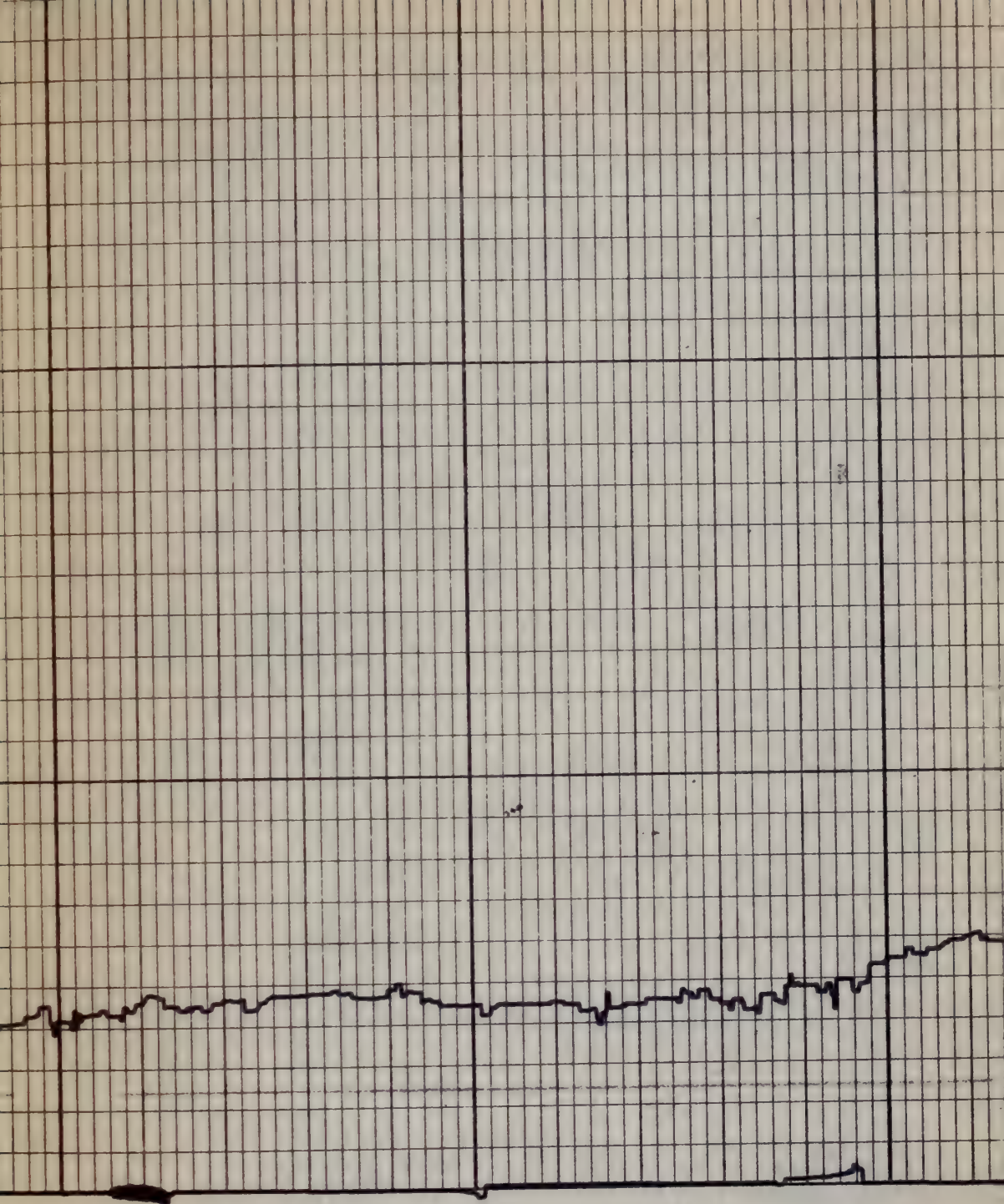
AFTER LOG

12"

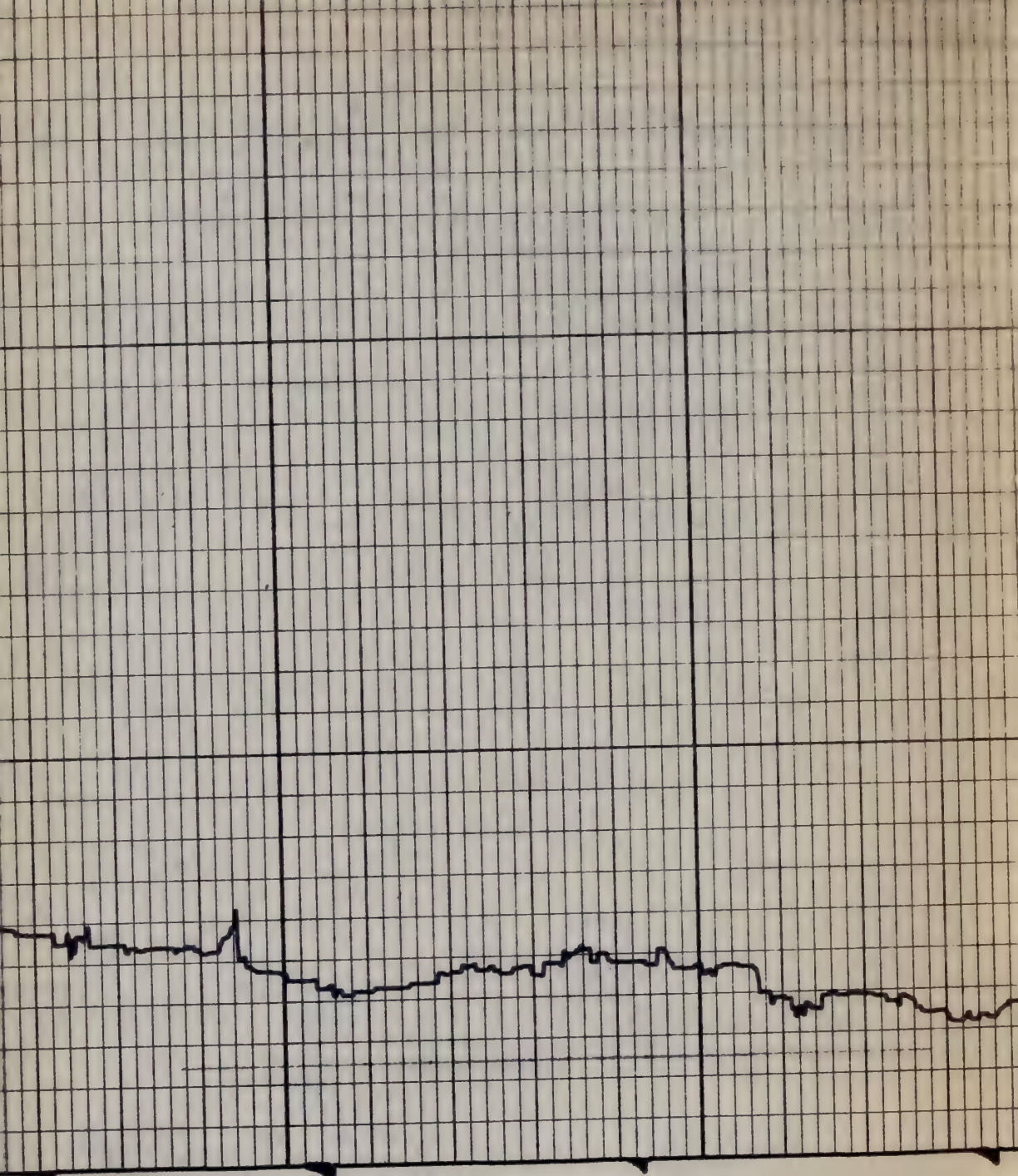
8"



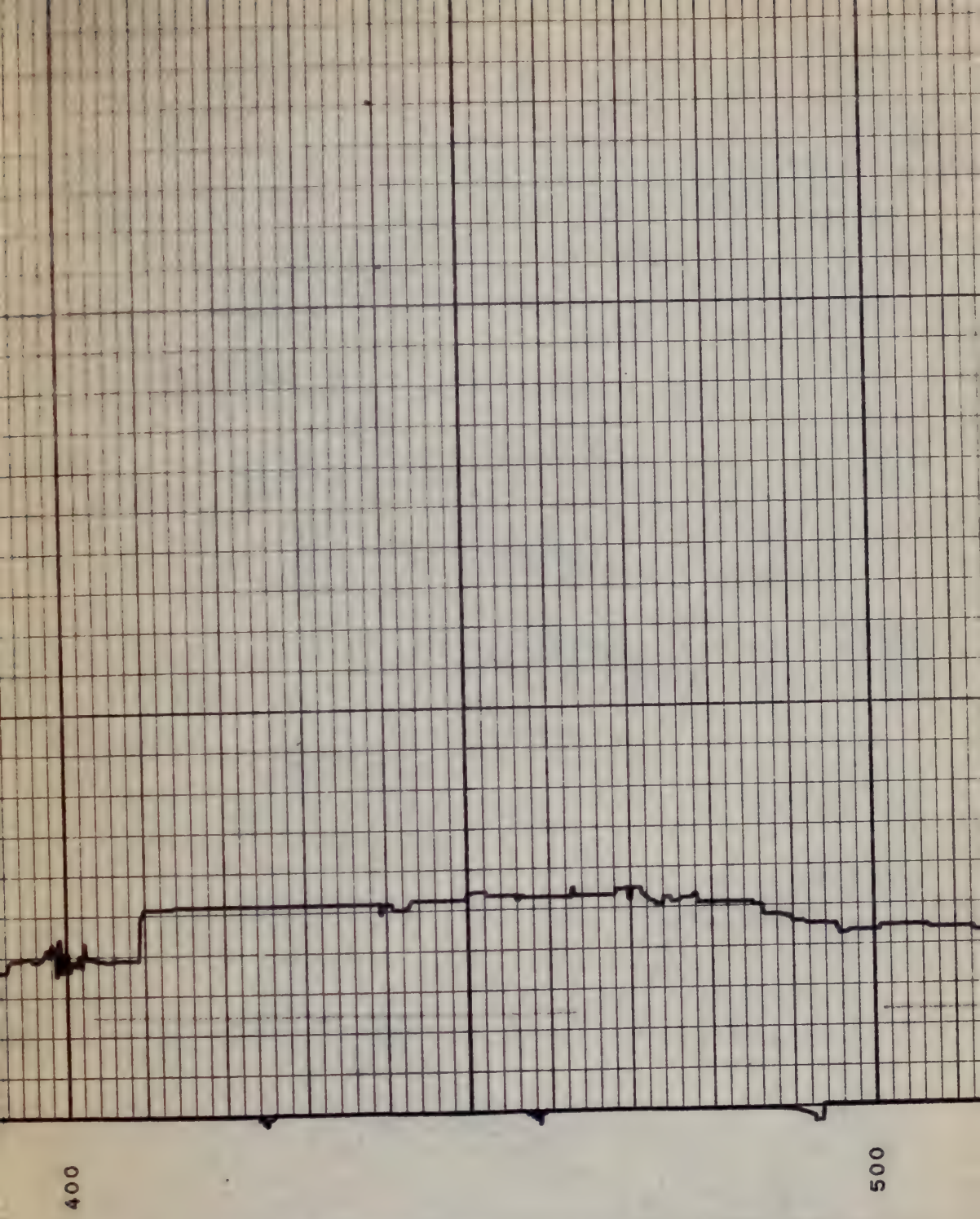
100



200

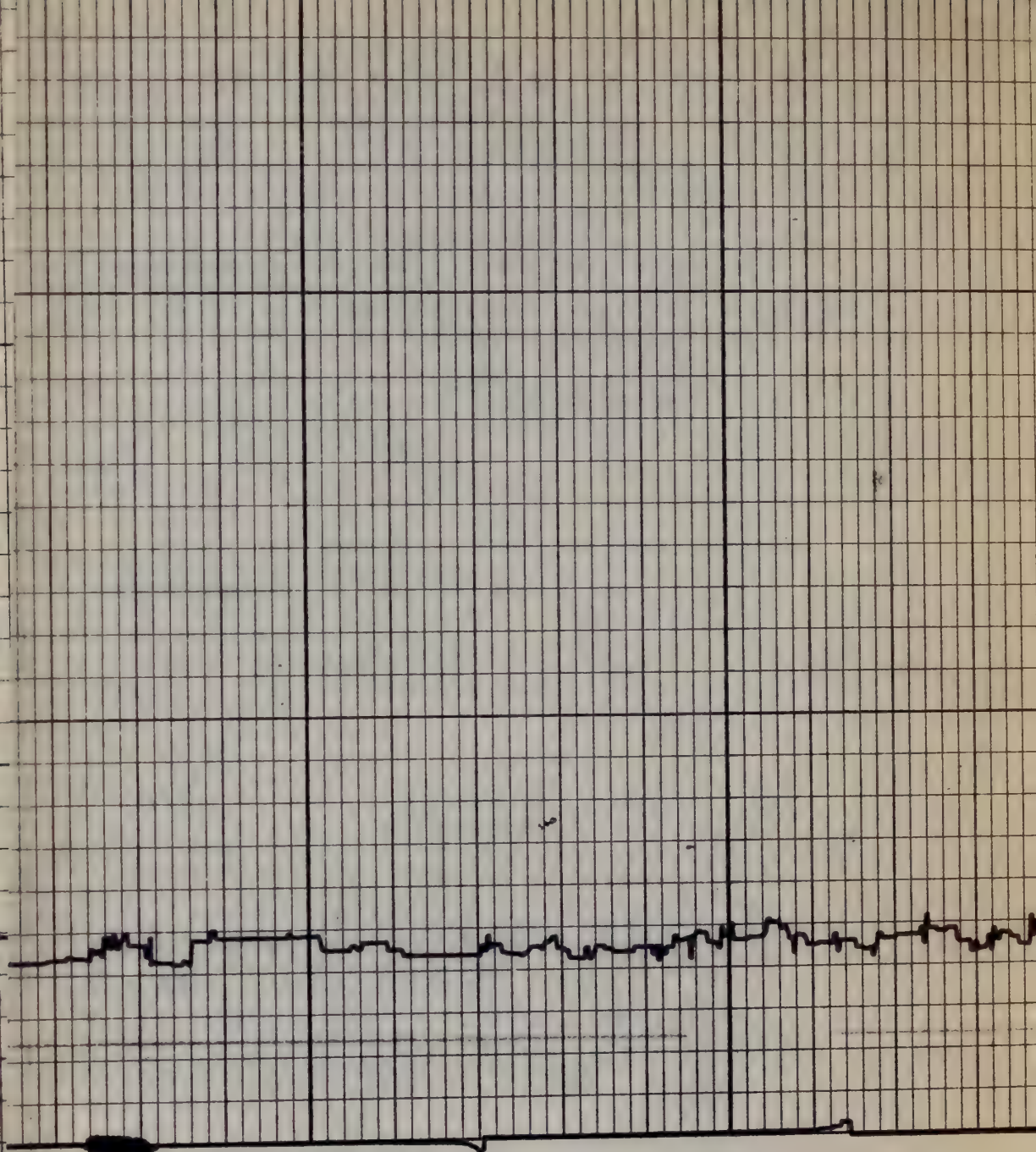


300

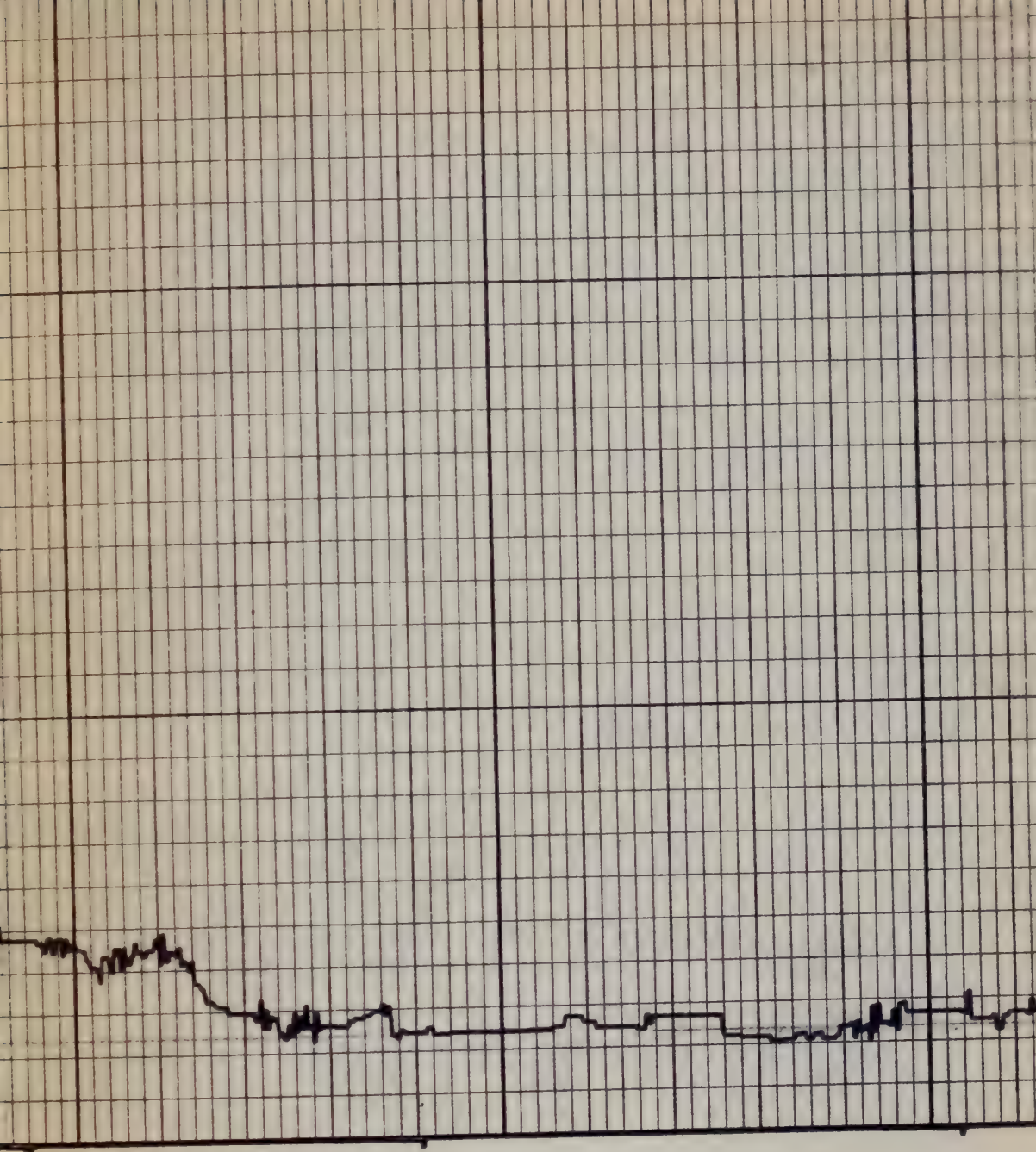


400

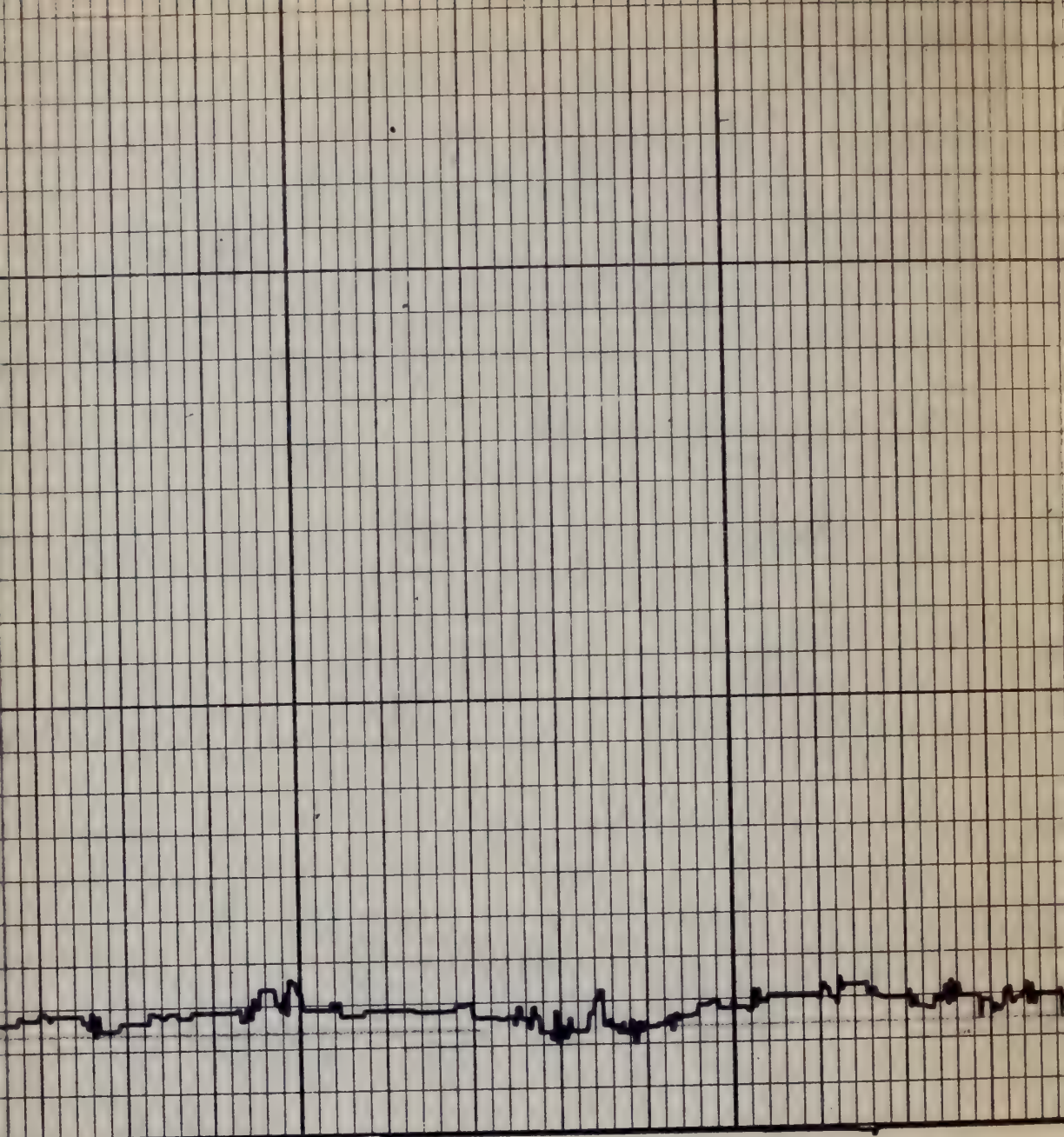
500



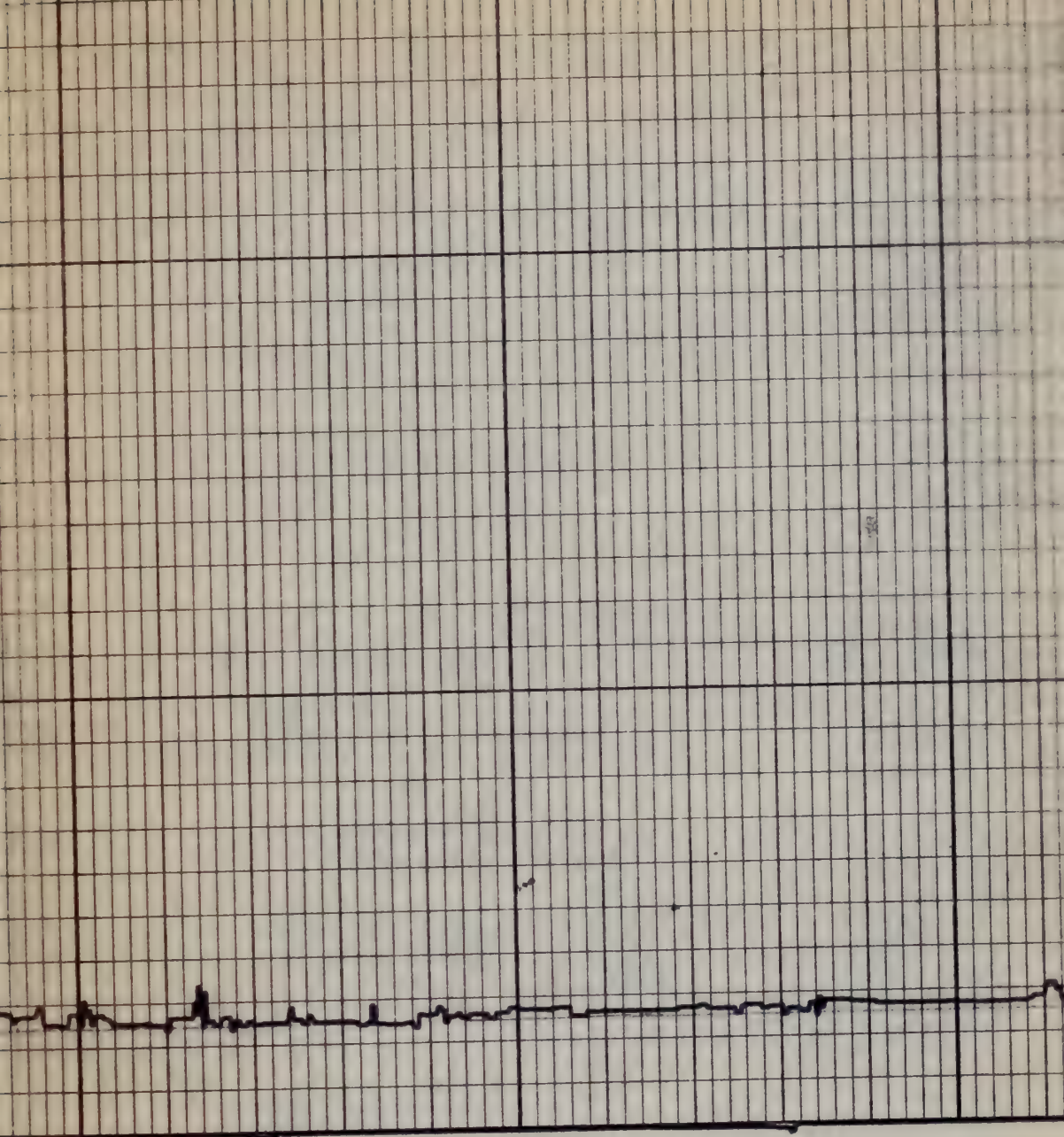
600



700

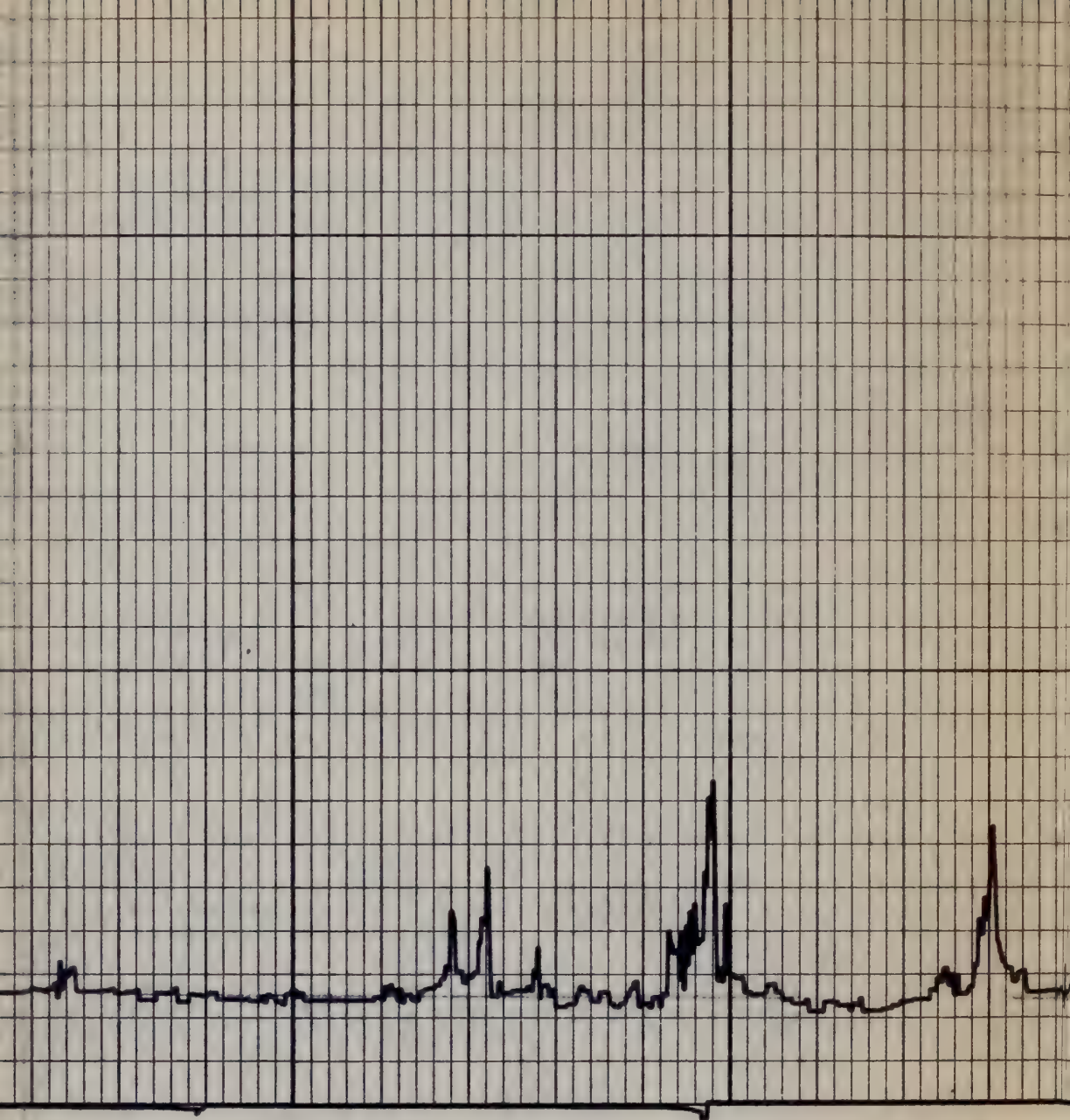


800

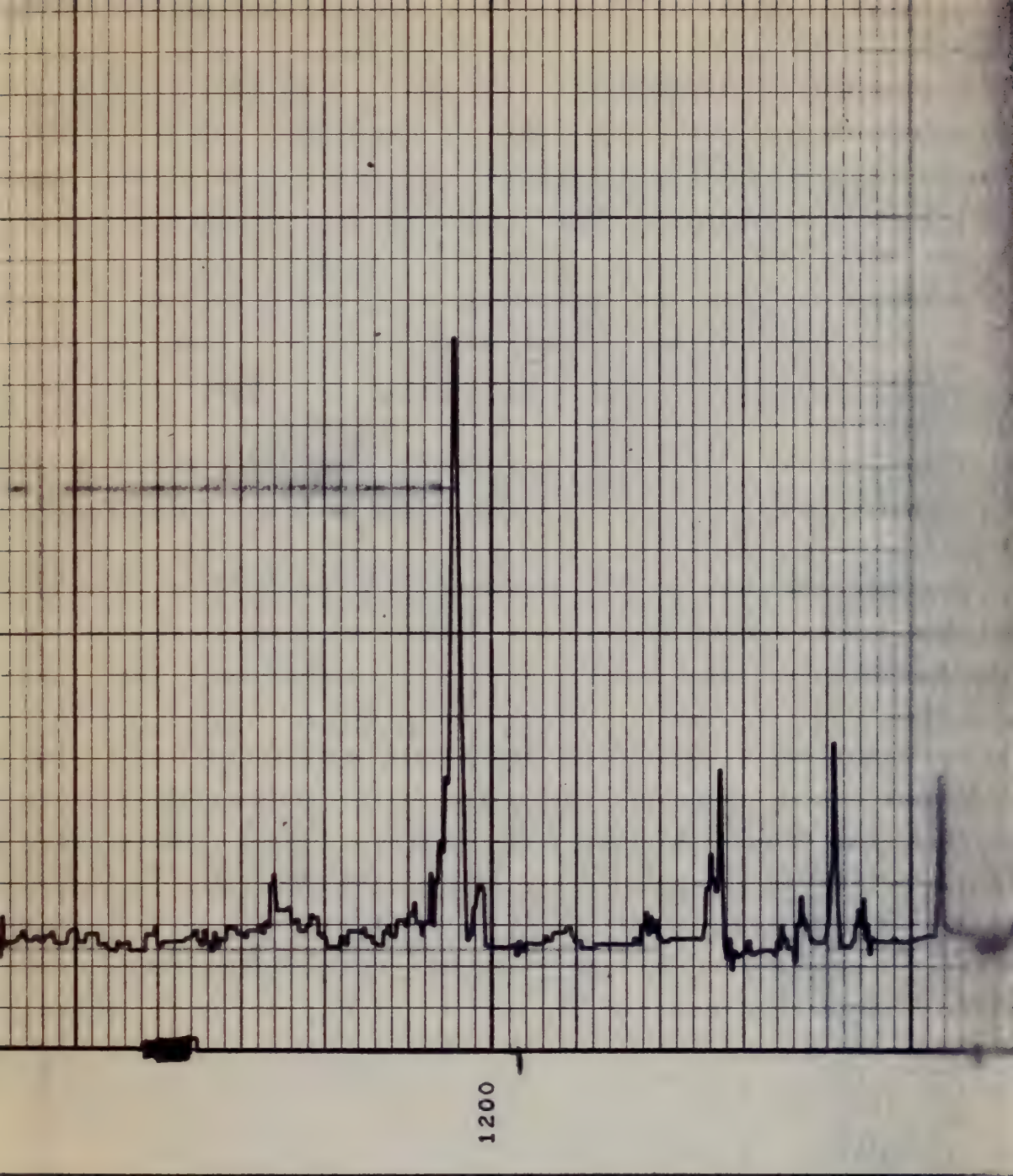


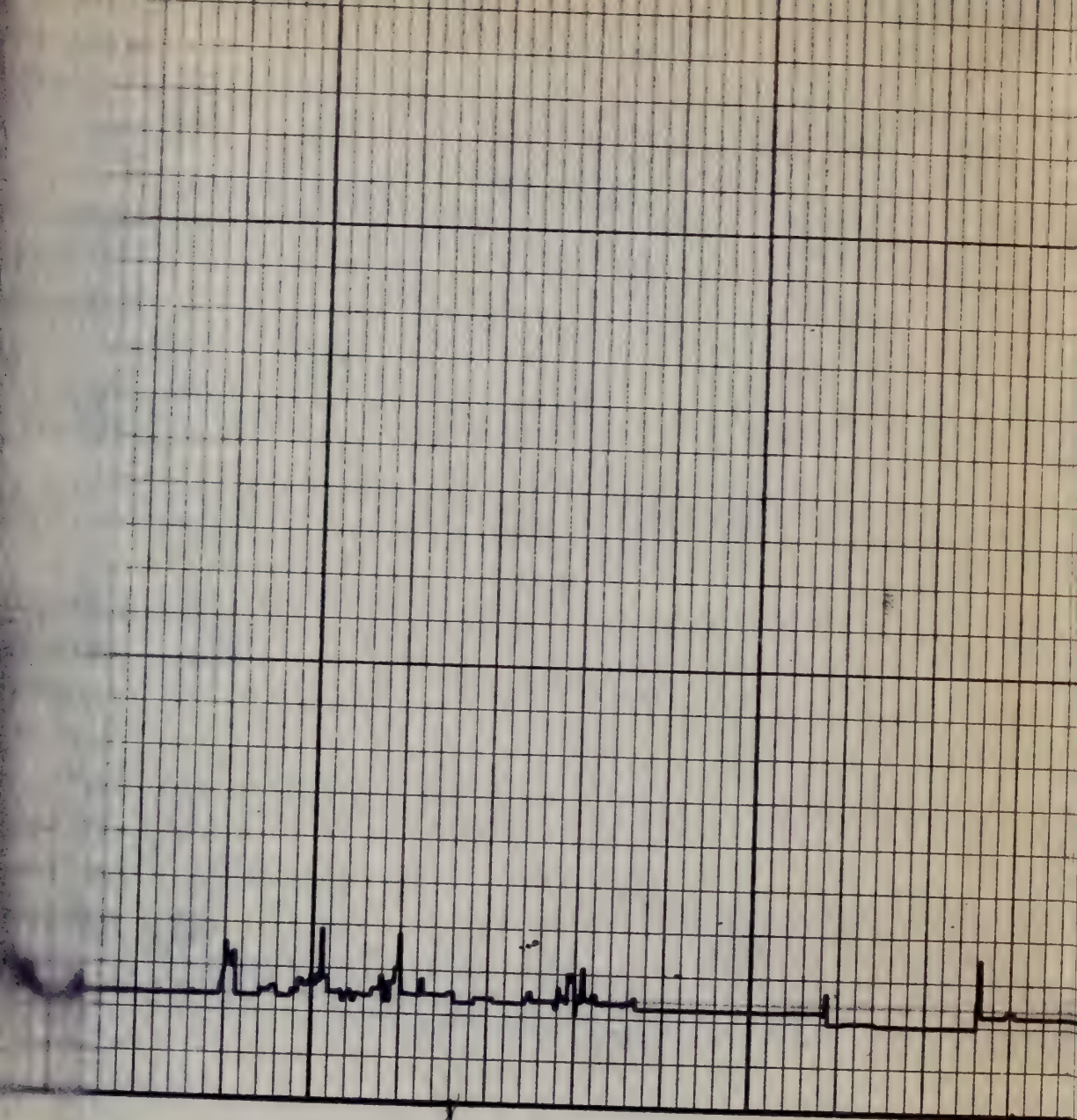
900

1000

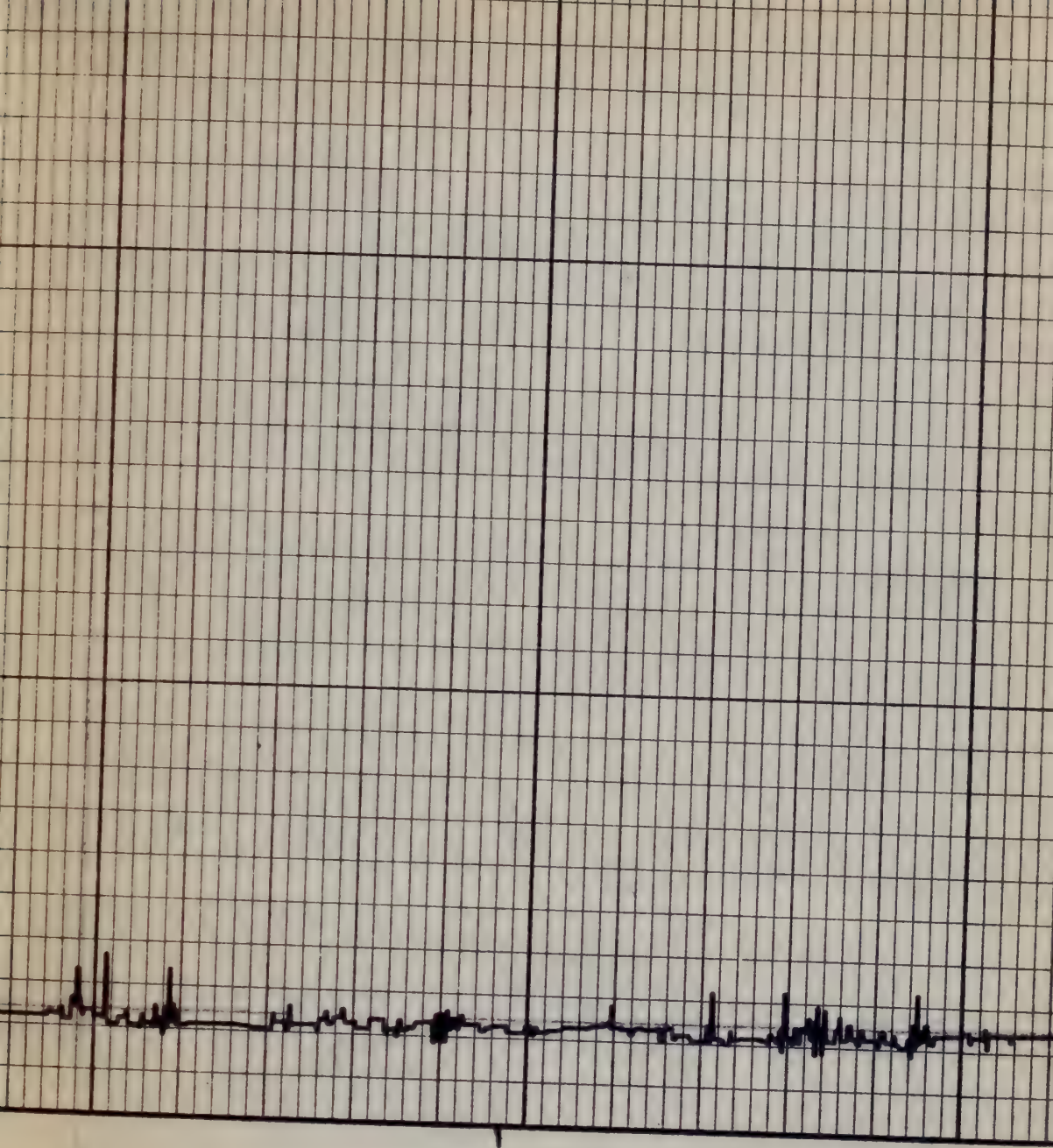


1100



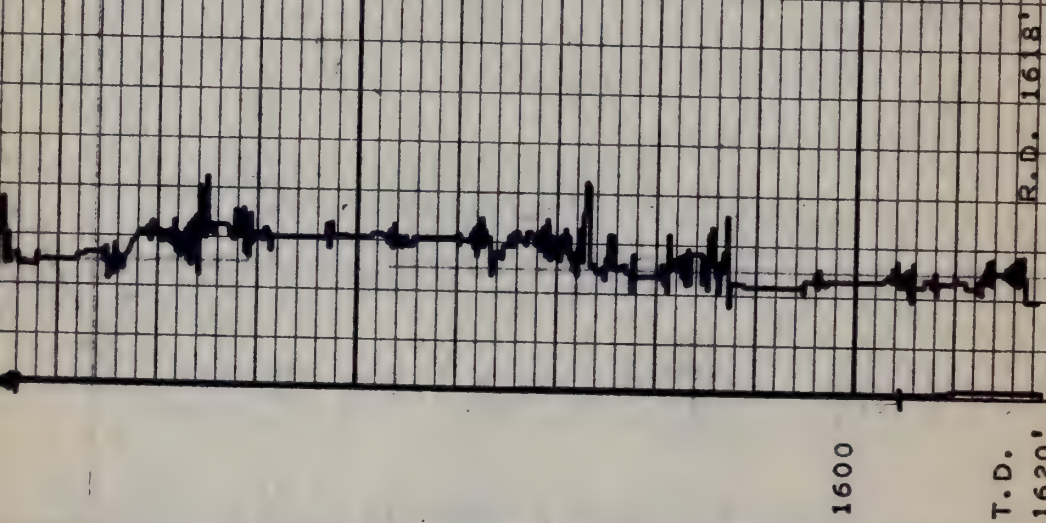


1300



1400

1500



CALIBRATION DATA

BEFORE LOG





Birdwell

Temperature Log

FILING NO.

COMPANY ATLANTIC RICHEFIELD COMPANY,

ET. AL.

WELL SORGHUM GULCH AQUIFER 1-A

FIELD

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

OTHER SERVICES:

V3D CAL FDL
GR/ENP ES

SEC. 7 TWP. 35 RGE. 96W

ELEVATIONS:

PERMANENT DATUM GROUND LEVEL ELEV. 6909'

LOG MEASURED FROM GL

KB.

DRILLING MEASURED FROM GL

DF.

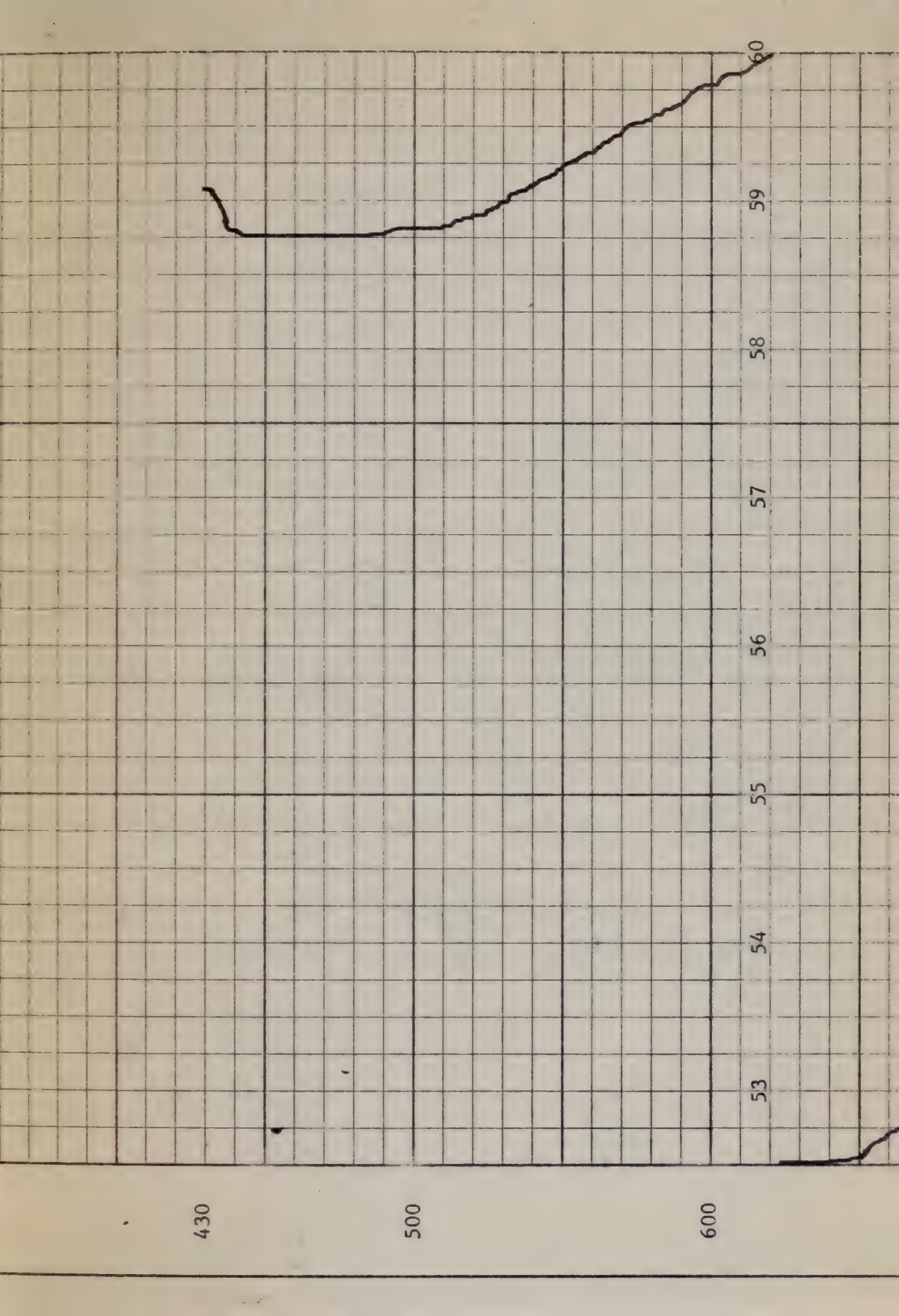
GL. 6909'

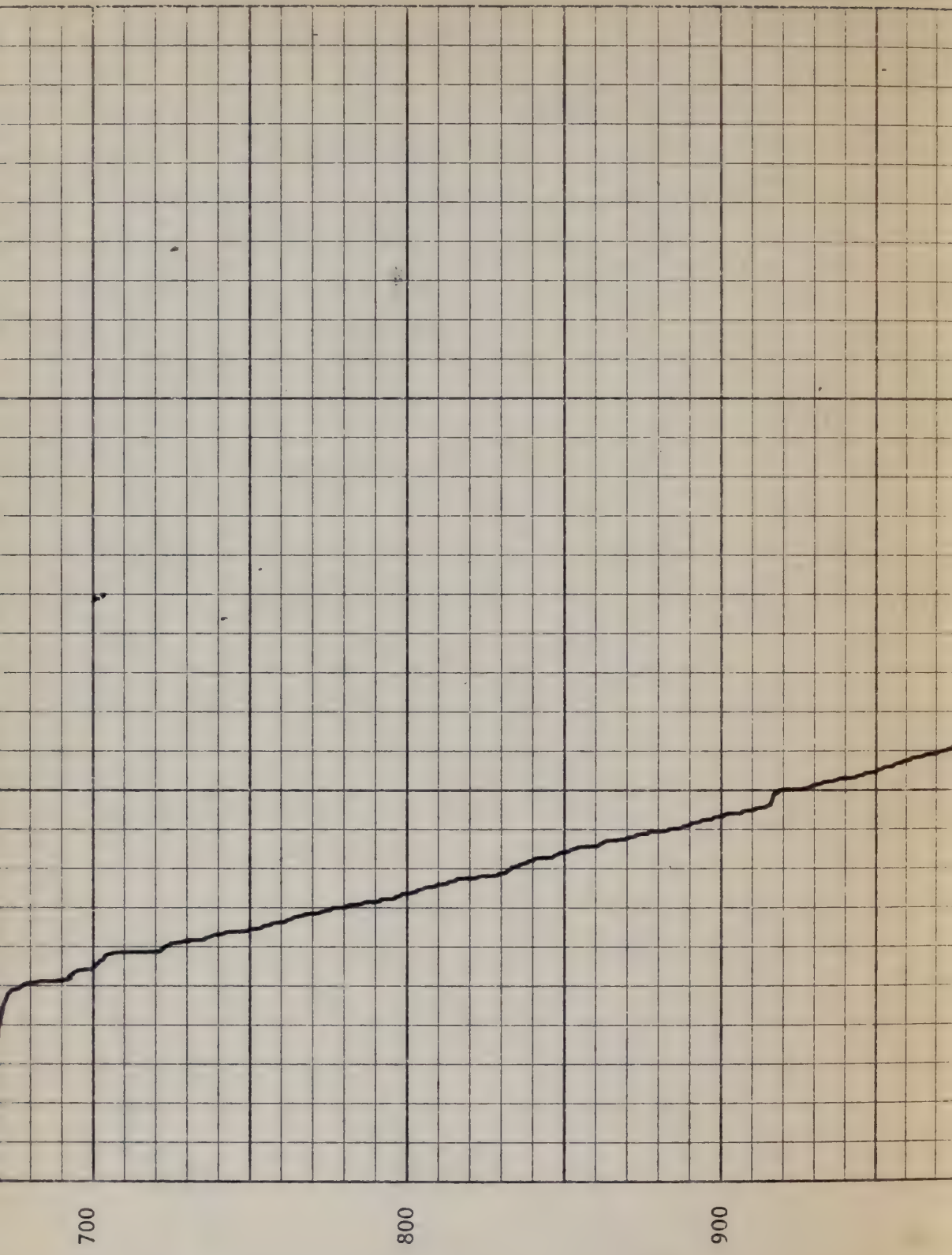
DATE	2 JULY 74
RUN NO.	1
TYPE LOG	TI
DEPTH-DRILLER	1621
DEPTH-LOGGER	1620
BOTTOM LOGGED INTERVAL	1618
TOP LOGGED INTERVAL	430
TYPE FLUID IN HOLE	WATER
SALINITY PPM CL.	
DENSITY LB./GAL.	
LEVEL	412
MAX. REC. TEMP.-DEG. F.	78°
OPR. RIG TIME	1/2 HR.
RECORDED BY	WILSON
WITNESSED BY	TAIT
LOCATION	LAS VEGAS

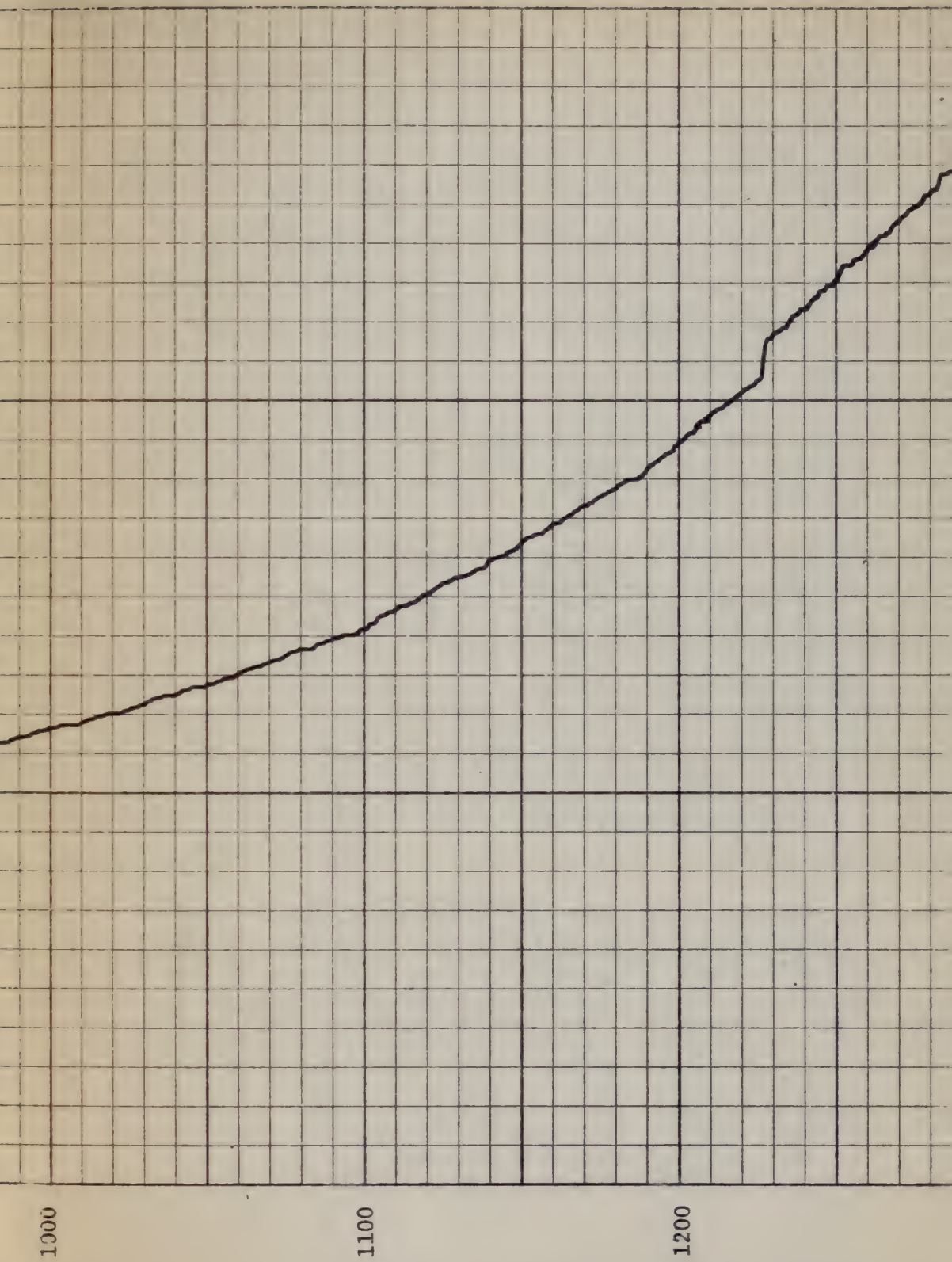
BORE HOLE RECORD

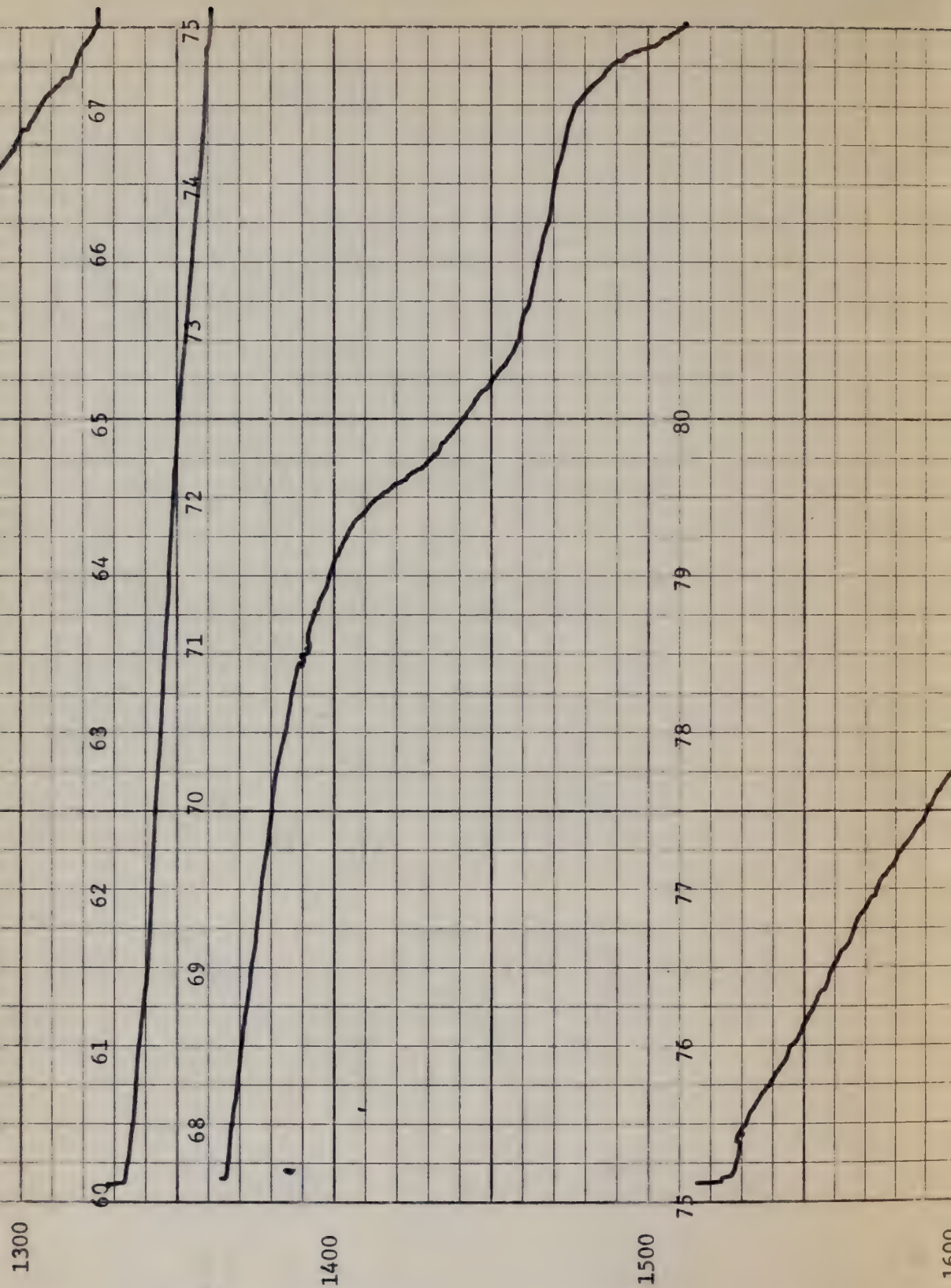
CASING RECORD

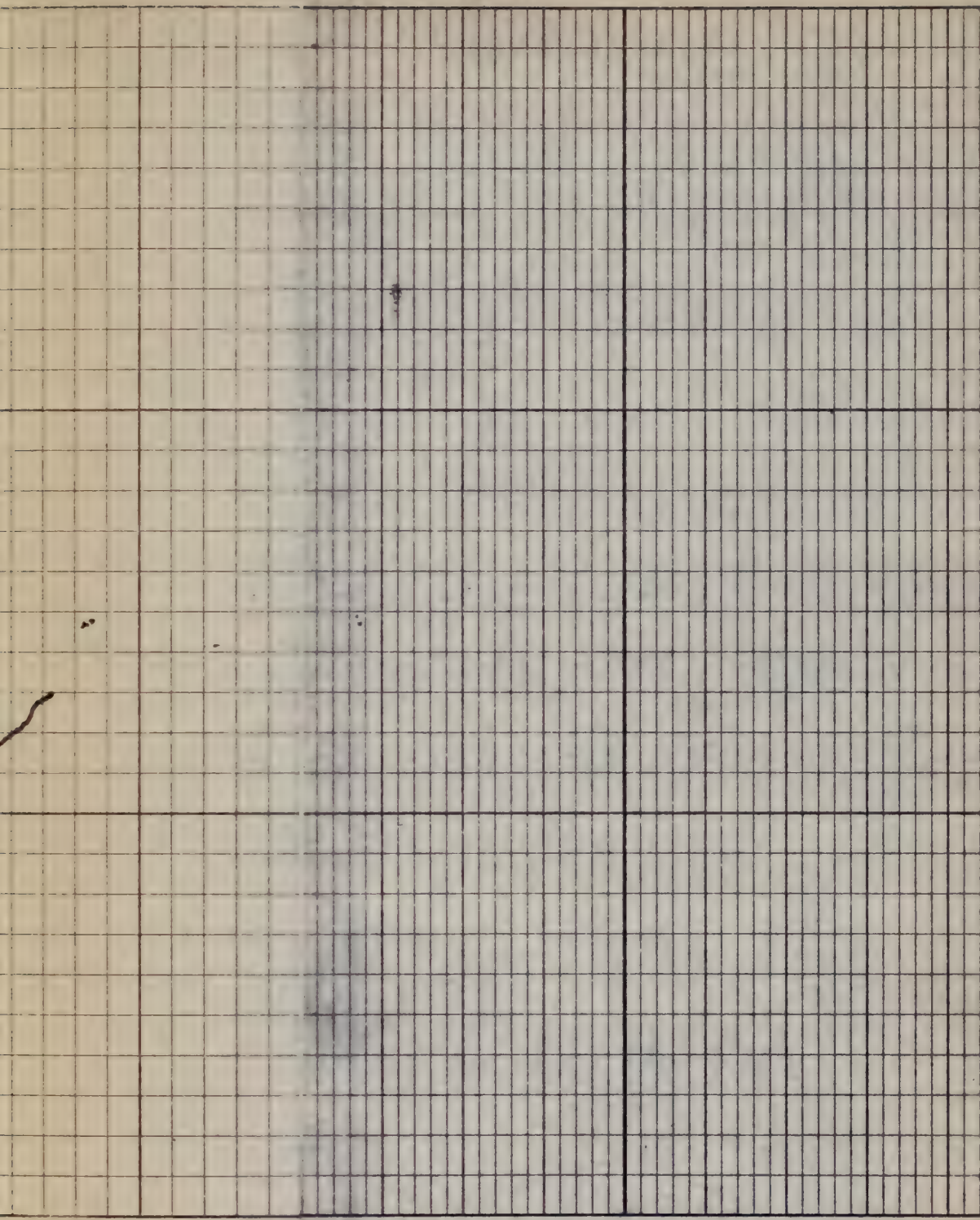
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
1	6-1/4"	62'	1621'	7"		0	62'



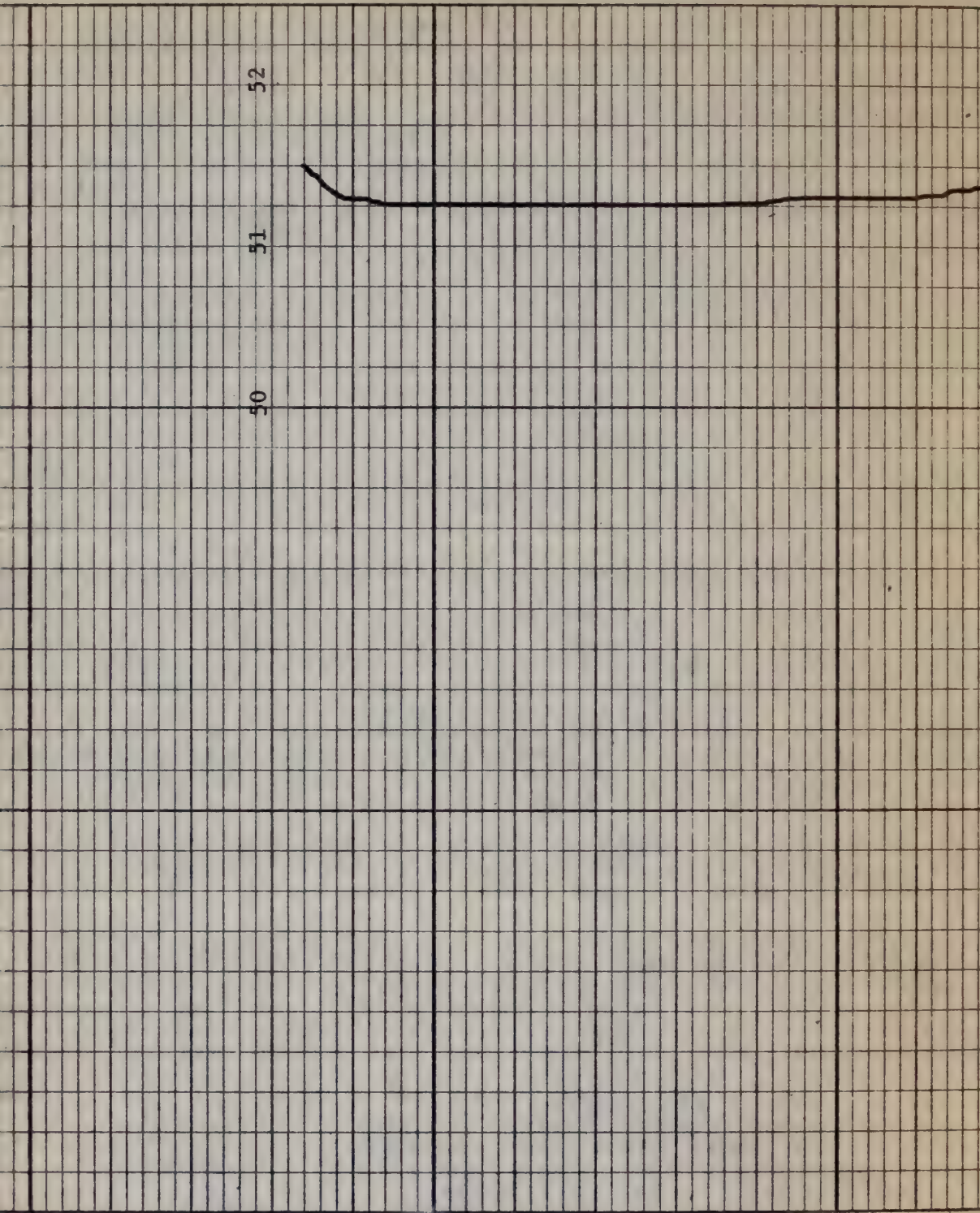






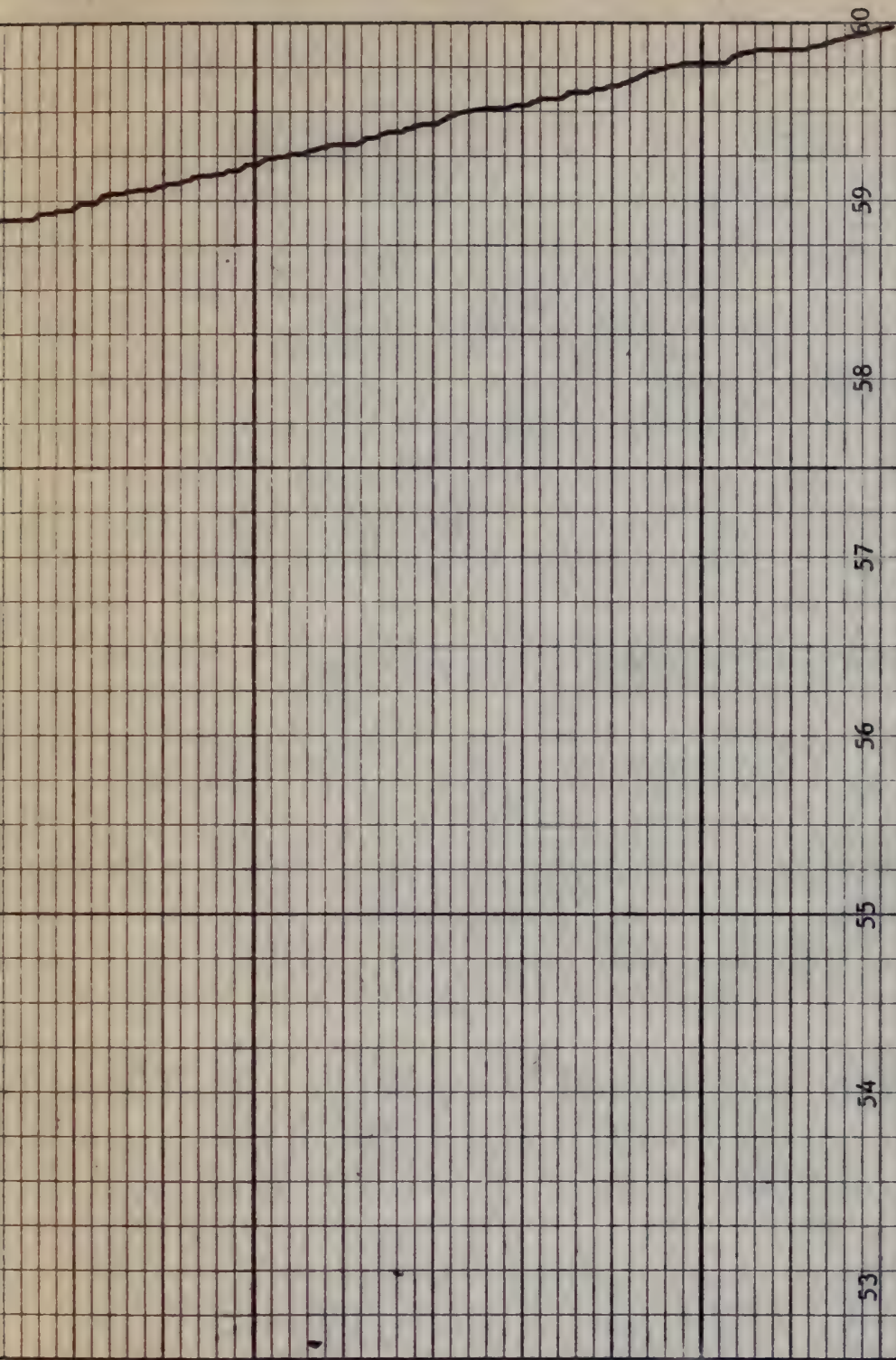


T.D.
1620'

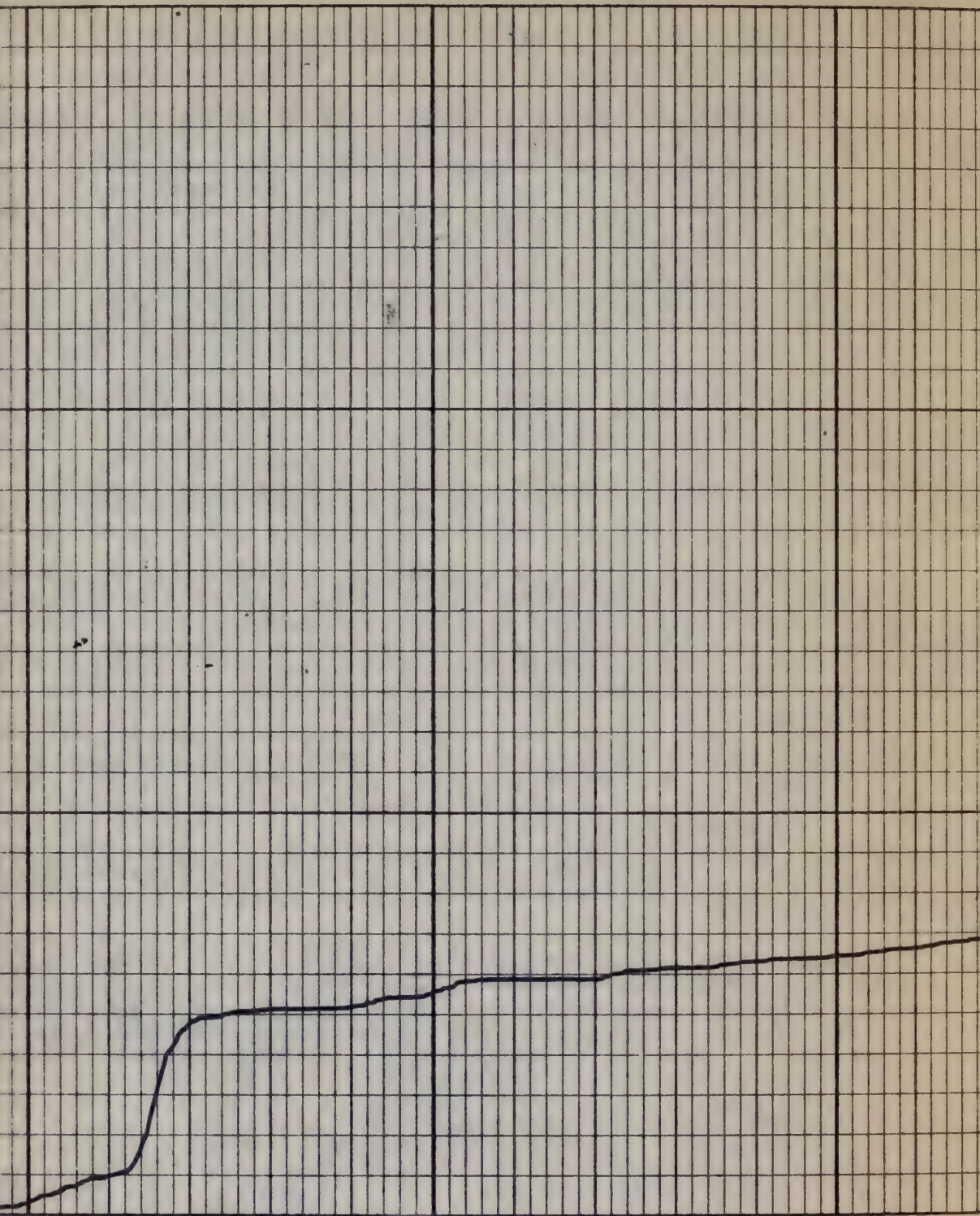


430

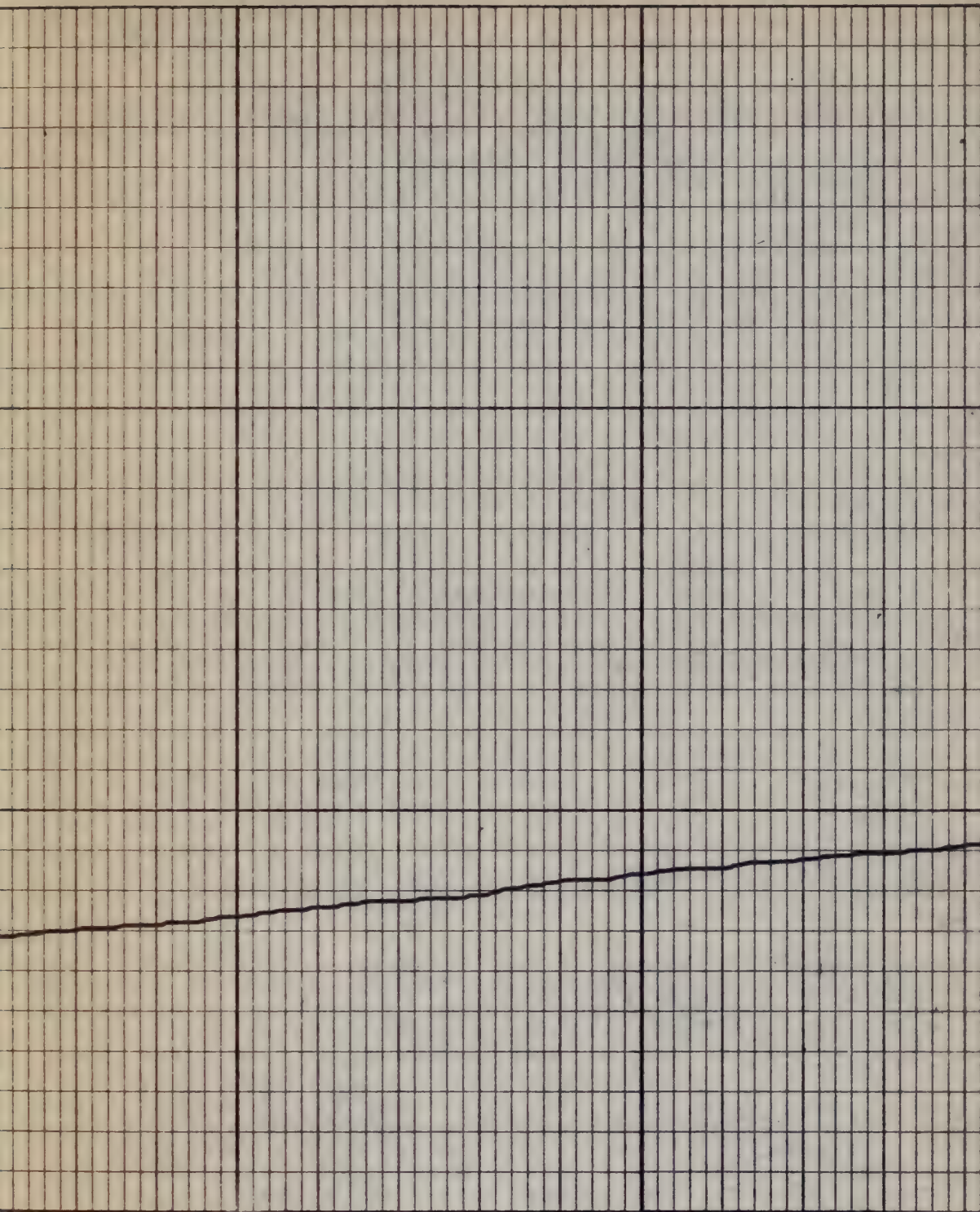
500

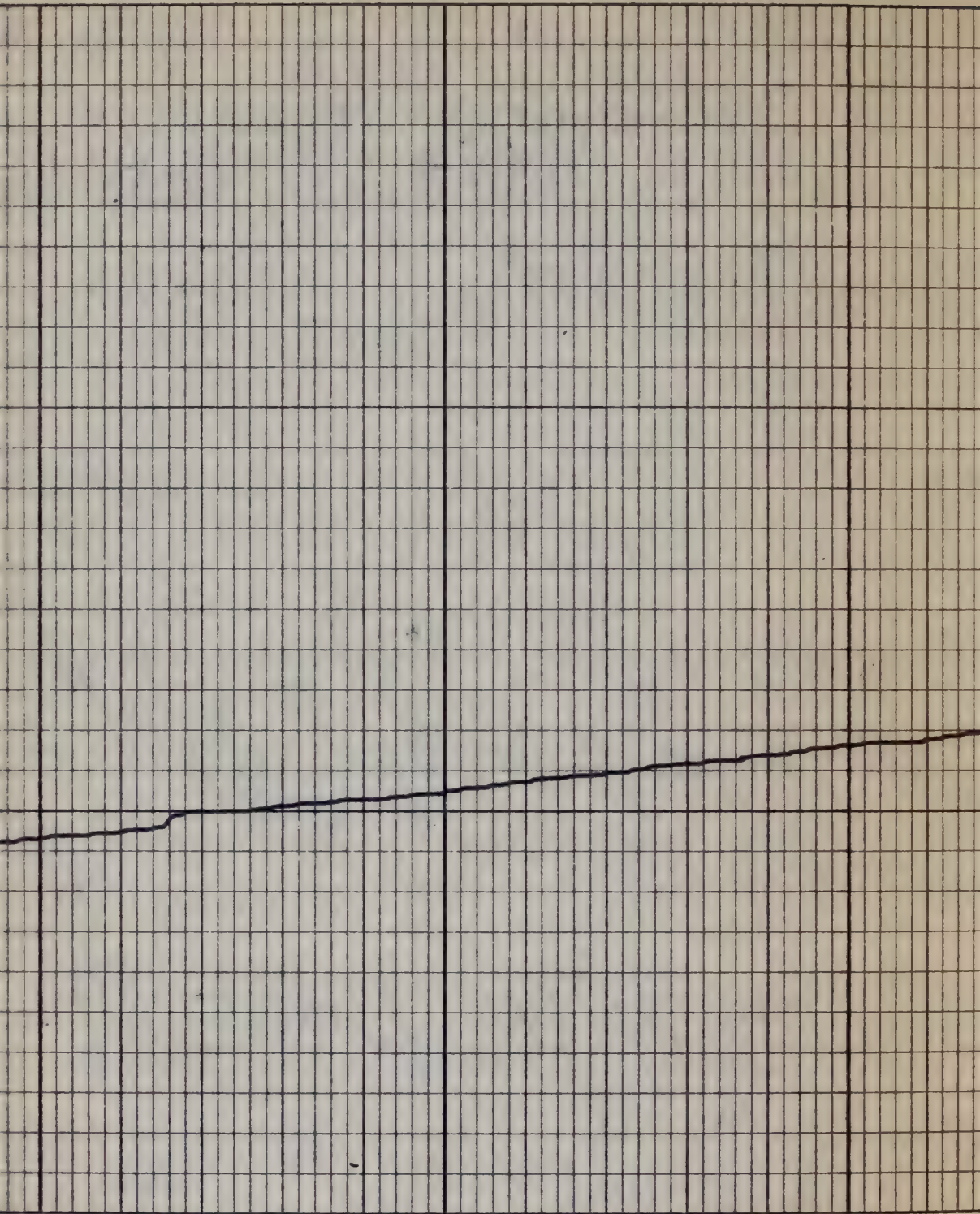


600



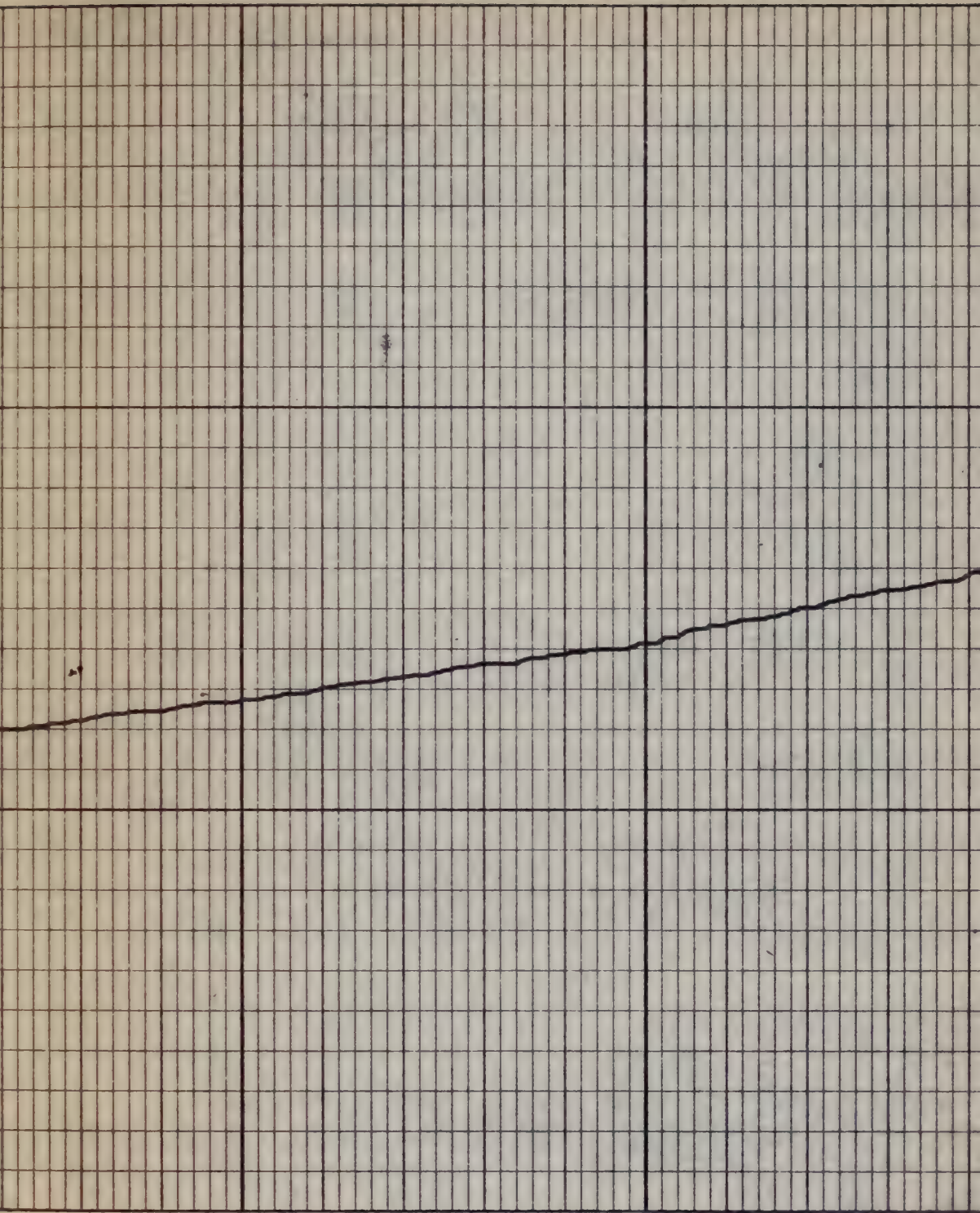
700



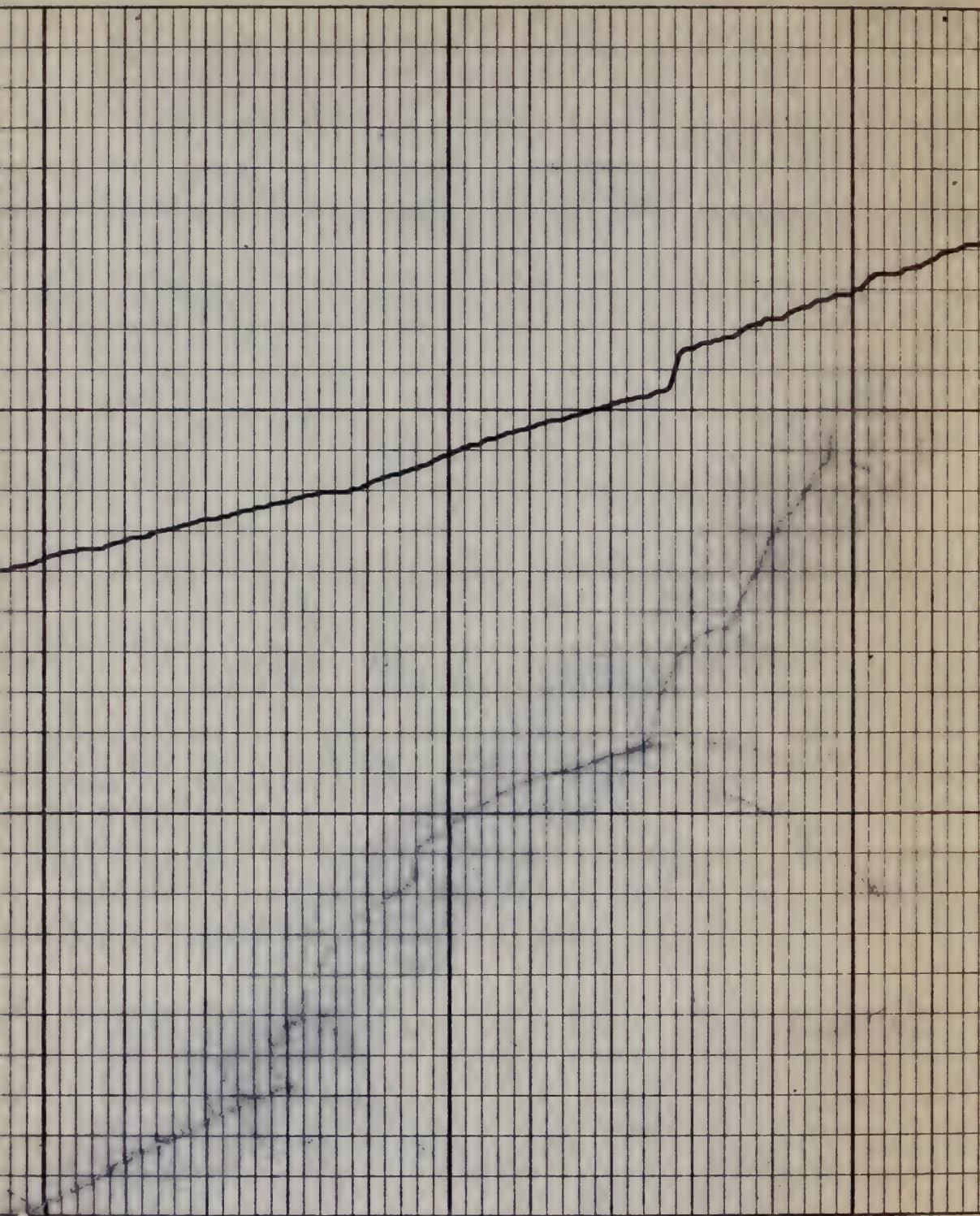


900

1000

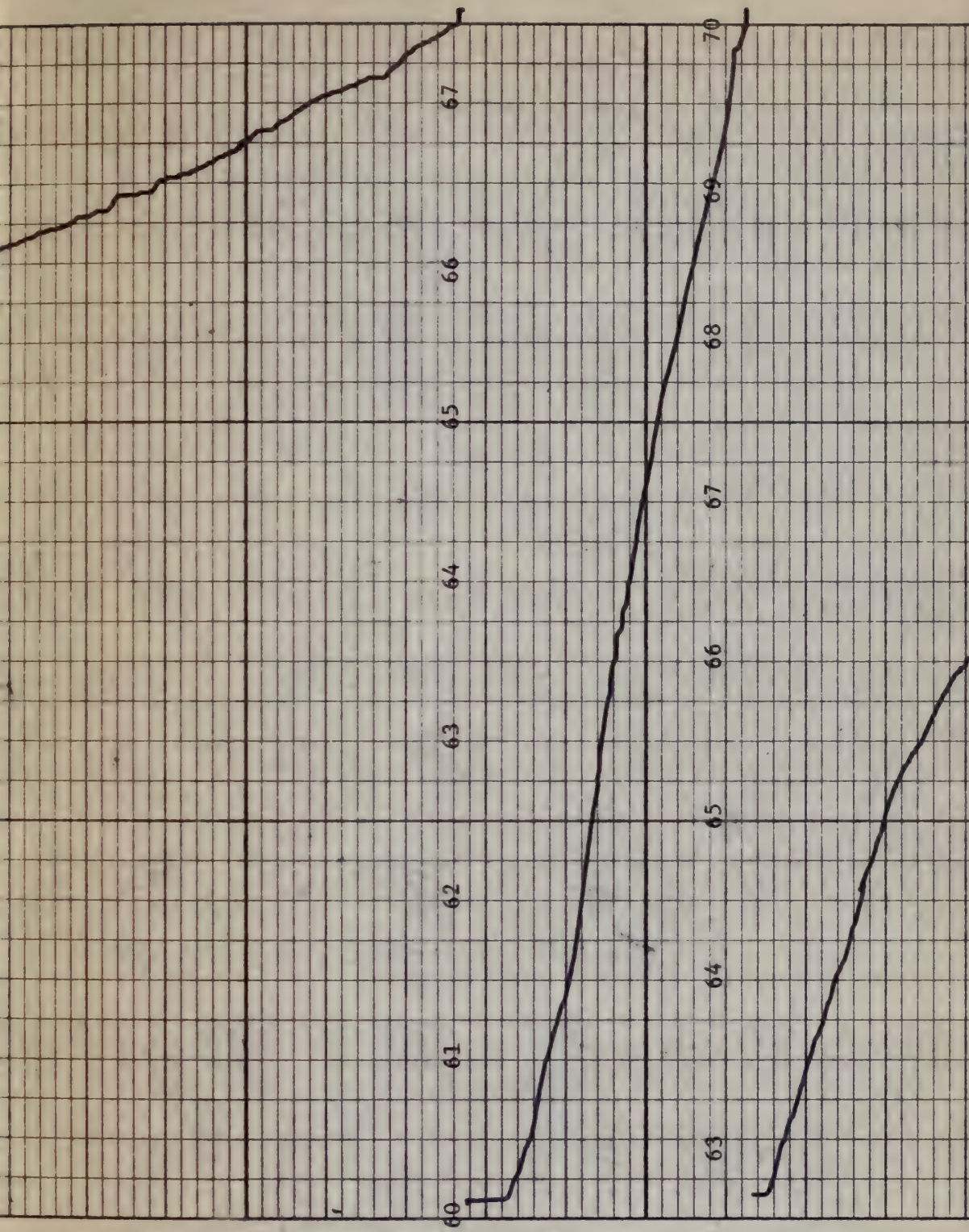


1100



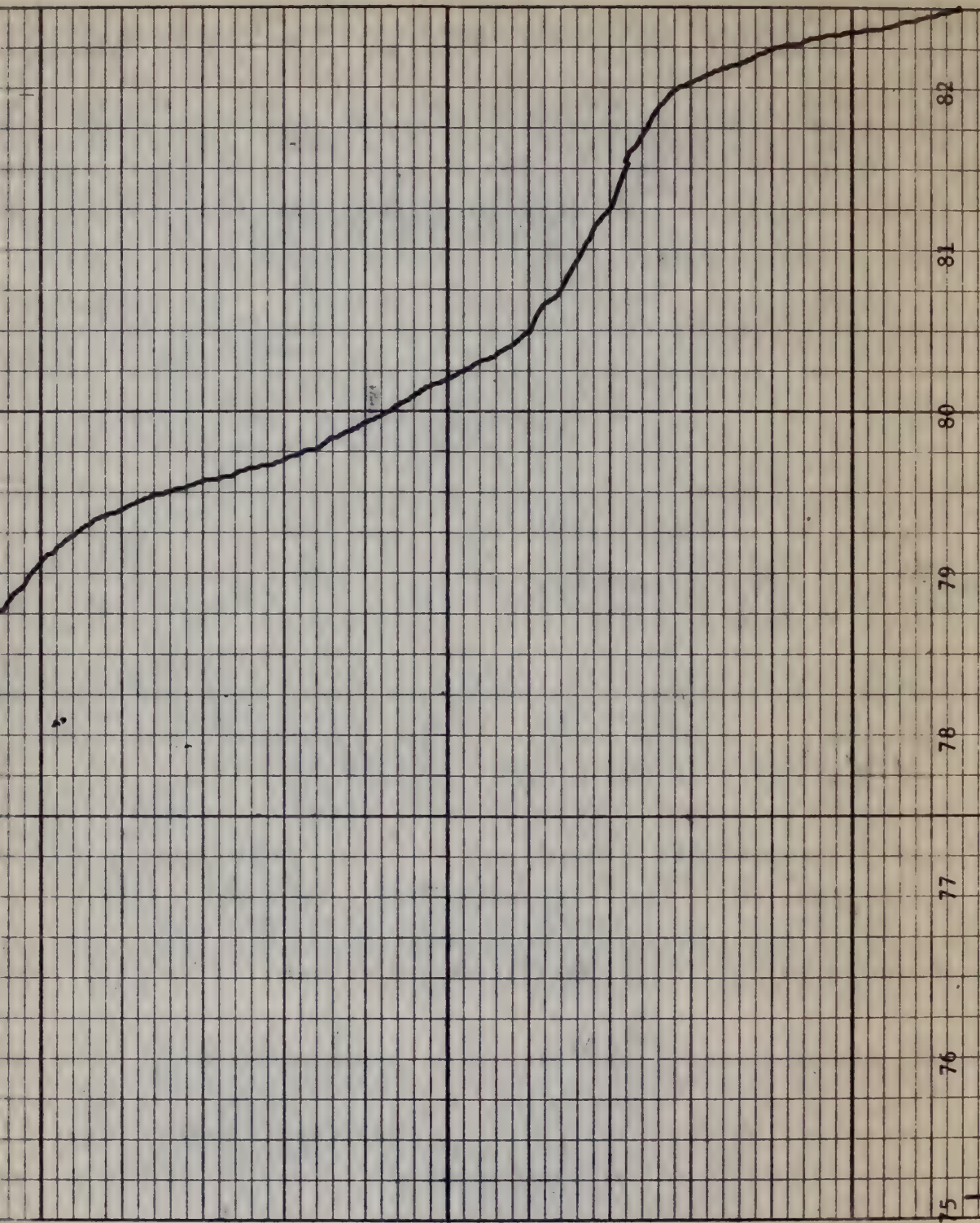
1200

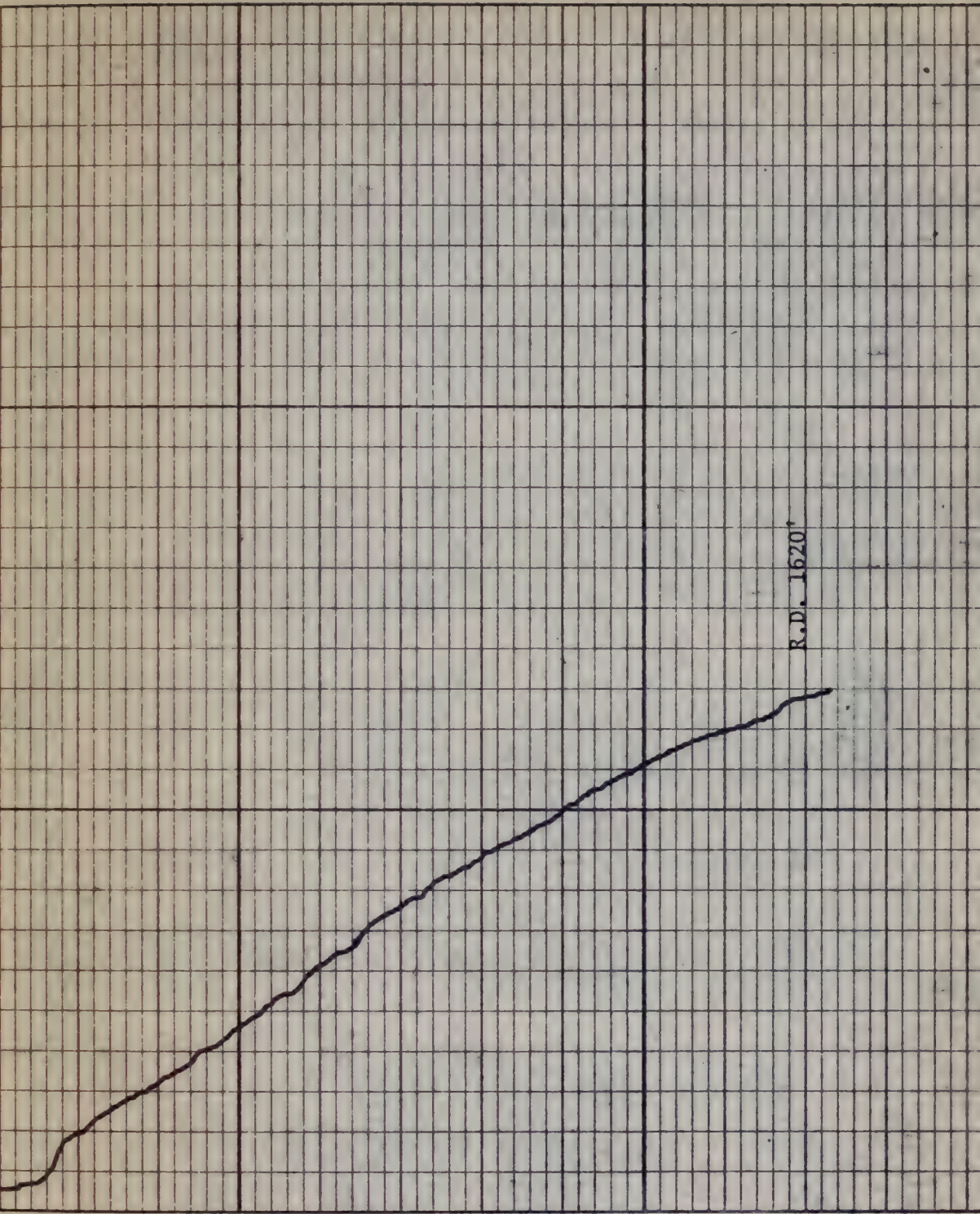
1300



1400

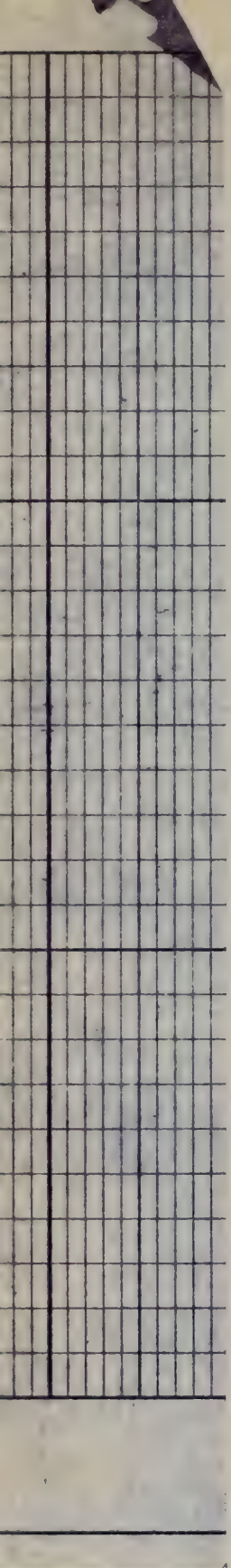
1500





1600

T.D.
1620'



Schlumberger

DUAL INDUCTION - LATEROLOG WITH LINEAR CORRELATION LOG

COUNTY RIO BLANCO

FIELD or LOCATION

WELL

AQUIFER TEST

NO. 1-B

COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

Location. API Serial No. 01036

Sec. 7 Twp. 3S Rge. 96W

Other Services:

FDC-GR ENG.
CNL-GR PRO.
BHC-GR

Permanent Datum: GL ; Elev.: 6909
Log Measured From GL 0 Ft. Above Perm. Datum
Drilling Measured From GL

Elev.: K.B. ----
D.F. ----
G.L. 6909

Date	7-21-74			
Run No.	ONE			
Depth-Driller	1638			
Depth-Logger	1640			
Btm. Log Interval	1636			
Top Log Interval	75			
Casing-Driller	8-5/8@ 60	@	@	@
Casing-Logger	72			
Bit Size	7-7/8			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens.	8.3	--		
Visc.				
pH				
Fluid Loss	---	-- ml	ml	ml
Source of Sample				
R _m @ Meas. Temp.	@	°F	@	°F
R _{mf} @ Meas. Temp.	@	°F	@	°F
R _{mc} @ Meas. Temp.	@	°F	@	°F
Source: R _{mf} R _{mc}				
R _m @ BHT	@	°F	@	°F
Time Since Circ.	14 HRS.			
Max. Rec. Temp.	90	°F	°F	°F
Equip. Location	5602 G.J.			
Recorded By	SCHNORR			
Witnessed By	TAIT			

SCALE CHANGES

[illegible]

REMARKS

Service Order No. - S0 #01036

☒ Surface determined sonde errors used for 6FF40.

☐ 6FF40 sonde error corrected for _____ inch

borehole signal at $R_m =$ _____

☐ 6FF40 zero set in hole at depth of _____ foot

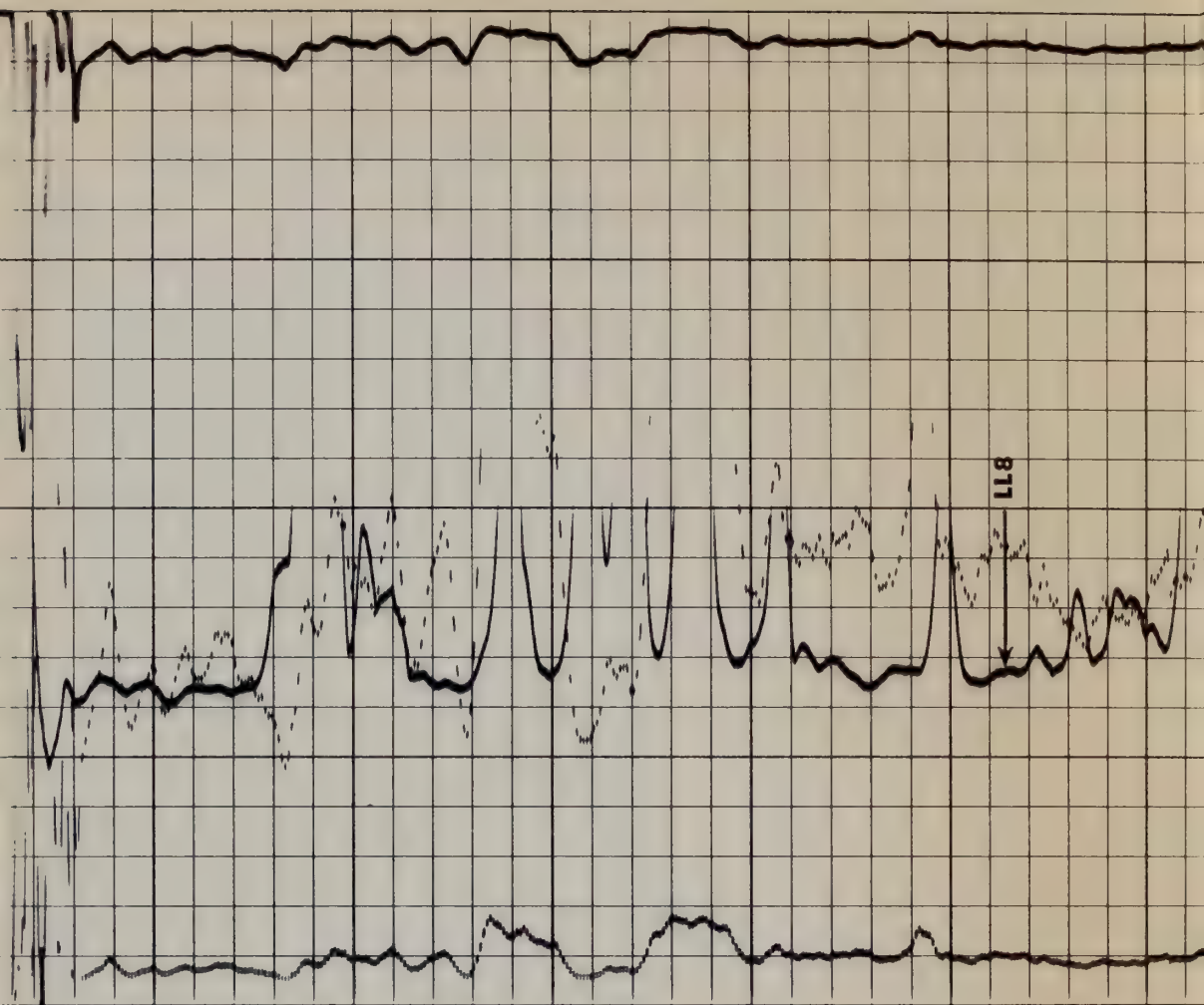
ALIBRATION:	BACKGND.	SOURCE	GALV INCR.	SENS TAP	SINS: TAP	TIME
	CPS.	CPS.	DIVISION	(FOR CAL)	(RECORD)	CONST
GAMMA RAY						

ALIBRATION:		BACKGND	SOURCE	GALV INCR.	SENS	TAP	SIGNS	TIME
		CPS.	CPS.	DIVISION	(FOR CAL)	(RECORD)	CONST	
AMMA	RAY.							

CALIBRATION:	BACKGND.	SOURCE	GALV. INCR.	SENS. TAP	SENS. TAP	TIME
	CPS.	CPS.	DIVISION	(FOR CAL.)	(RECORD)	CONST.
GAMMA RAY:						

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

<div> <div>SPONTANEOUS-POTENTIAL</div> <div>MILLIVOLTS</div> </div>		<div> <div>CONDUCTIVITY</div> <div> <div>MILLIMHOS/M</div> <div>=</div> <div> <div>1000</div> <div>OHMS. M²/M</div> </div> </div> </div>	
<div> <div> <div>—</div> <div> <div>20</div> <div>↔</div> <div>MV</div> </div> <div>+</div> </div> </div>		<div> <div>DEEP INDUCTION LOG</div> <div> <div>400</div> <div>200</div> <div>0</div> </div> </div>	
		<div> <div>RESISTIVITY</div> <div>OHMS. M²/M</div> </div>	
		<div> <div>DEEP INDUCTION LOG</div> <div> <div>0</div> <div>100</div> </div> </div>	
		<div> <div>DEEP INDUCTION LOG</div> <div> <div>0</div> <div>1000</div> </div> </div>	
		<div> <div>AVERAGED LATEROLOG - 8</div> <div> <div>0</div> <div>100</div> </div> </div>	
		<div> <div>AVERAGED LATEROLOG - 8</div> <div> <div>0</div> <div>1000</div> </div> </div>	

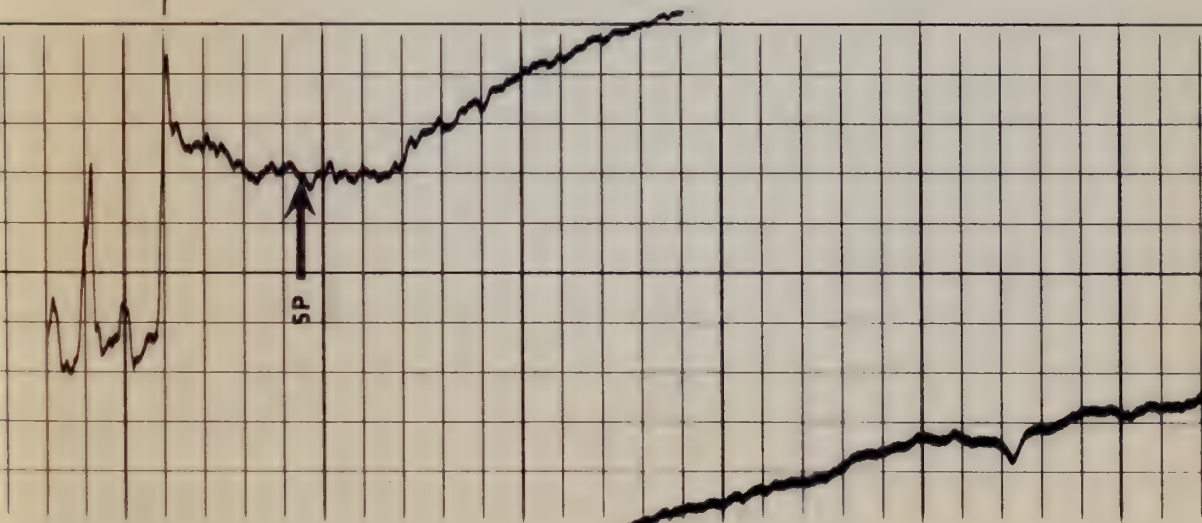
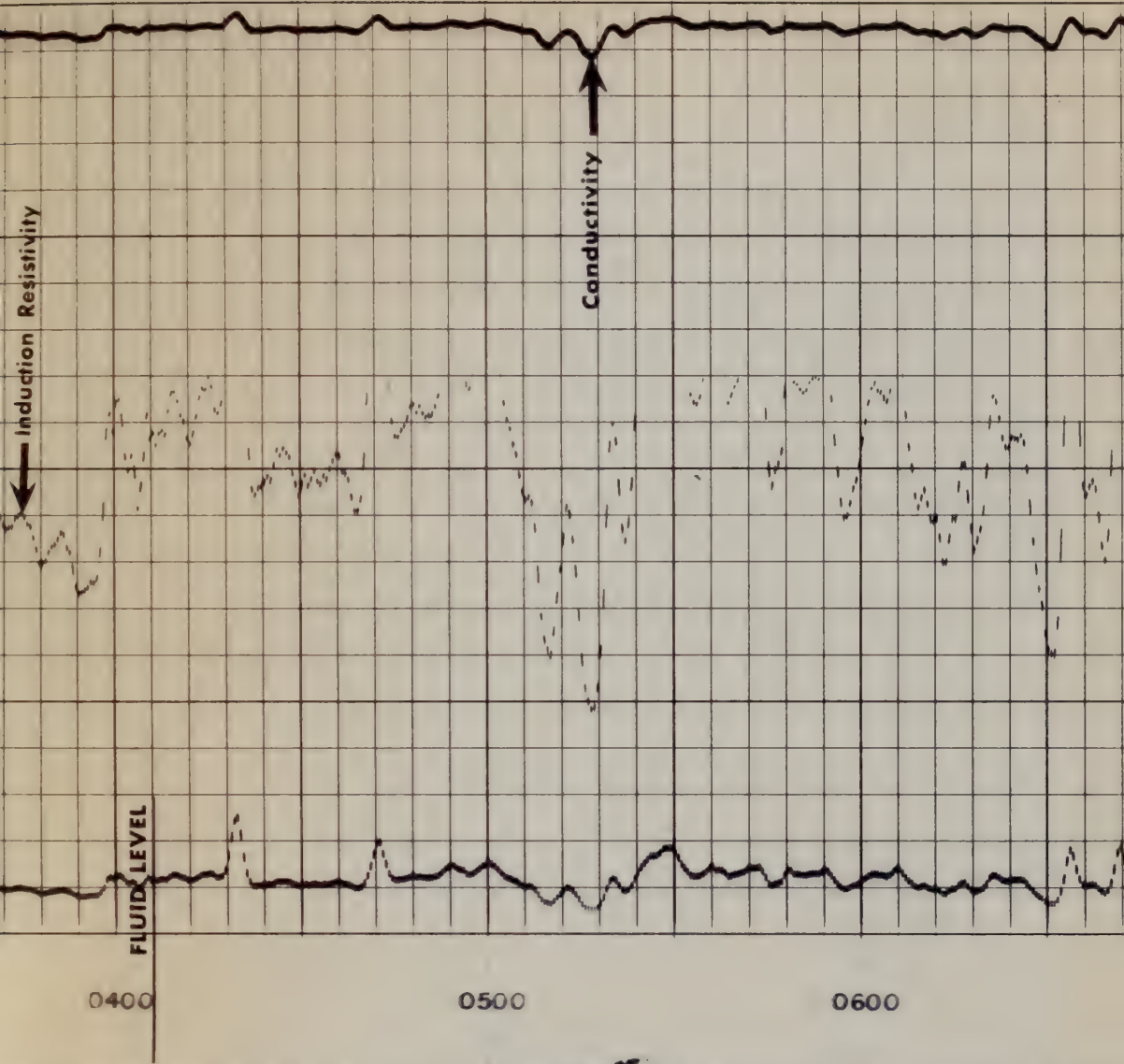


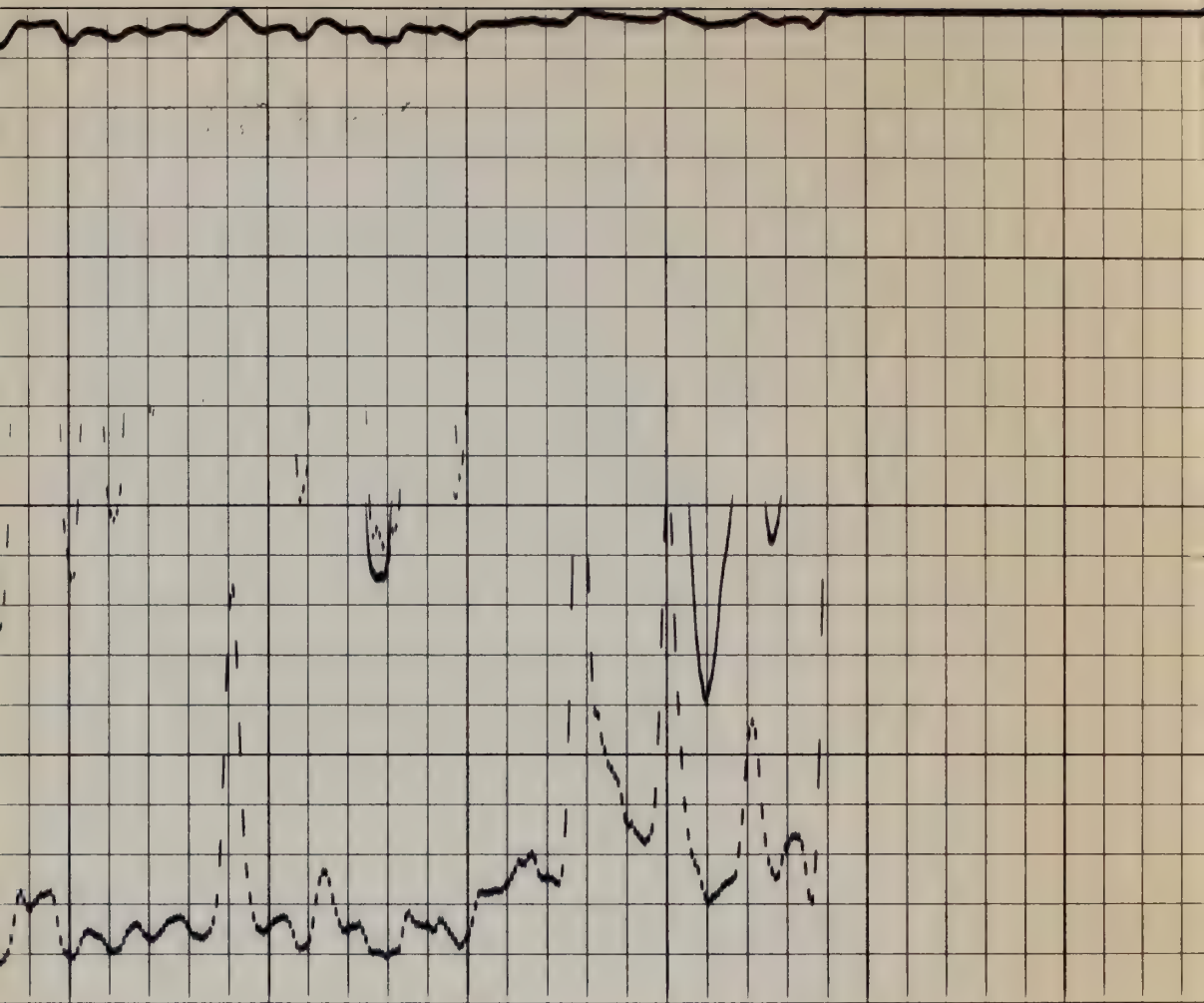
Casing

0100

0200

0300

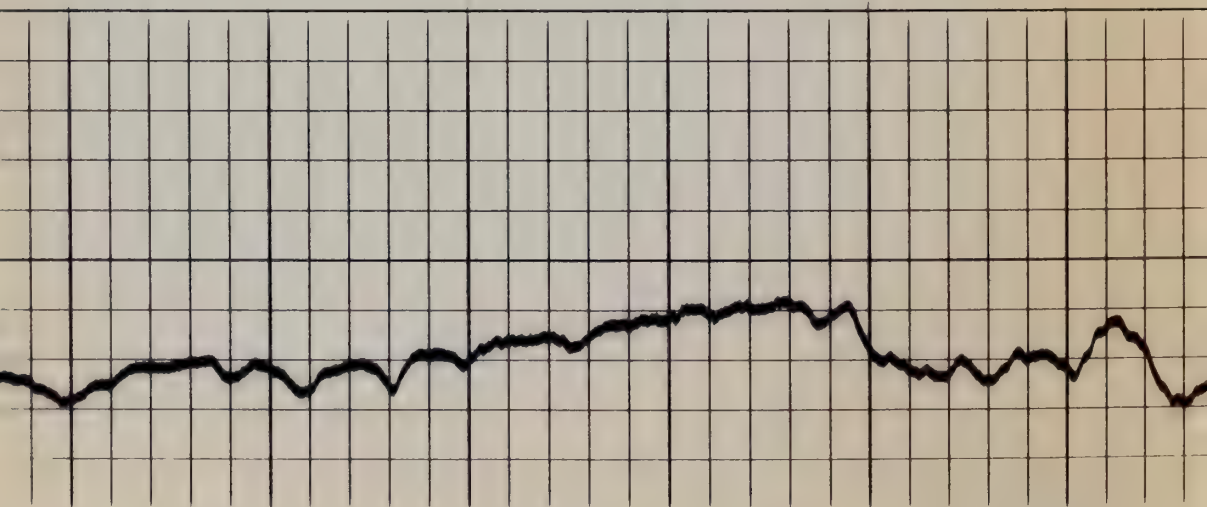


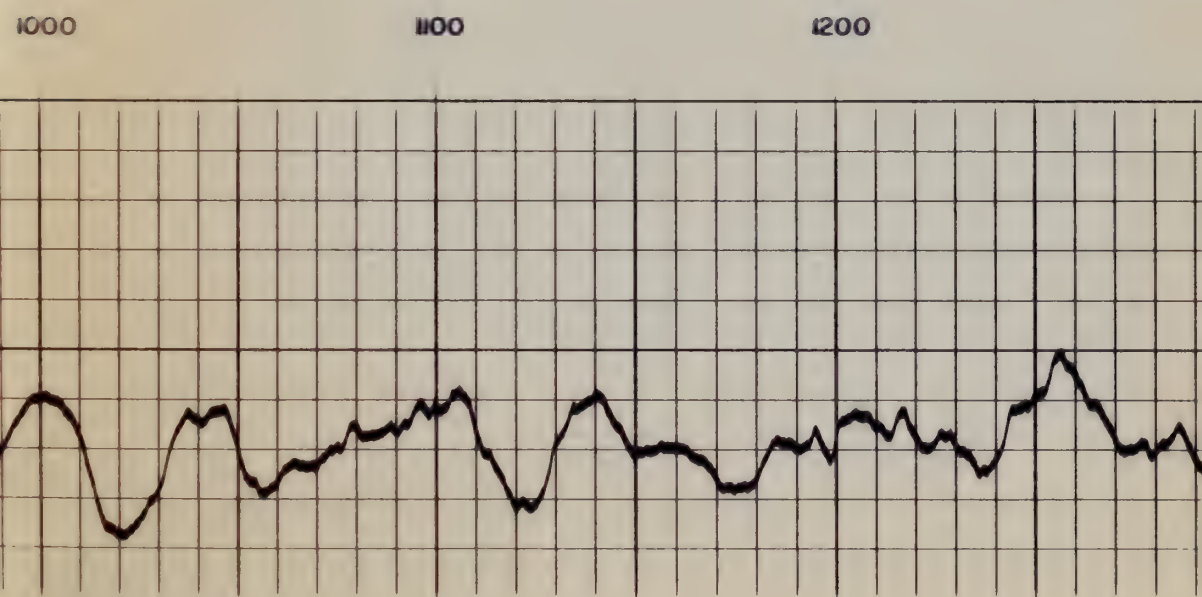
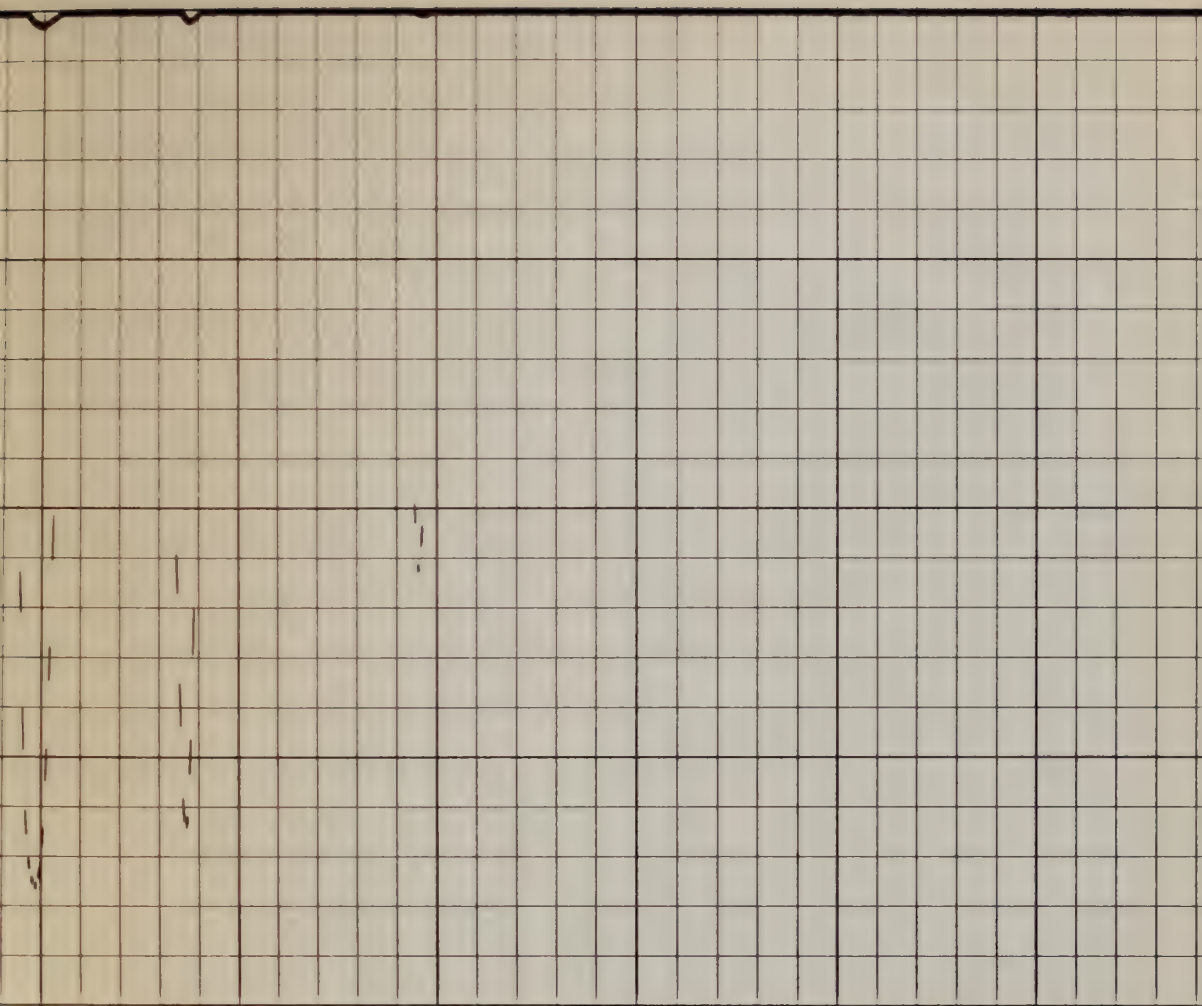


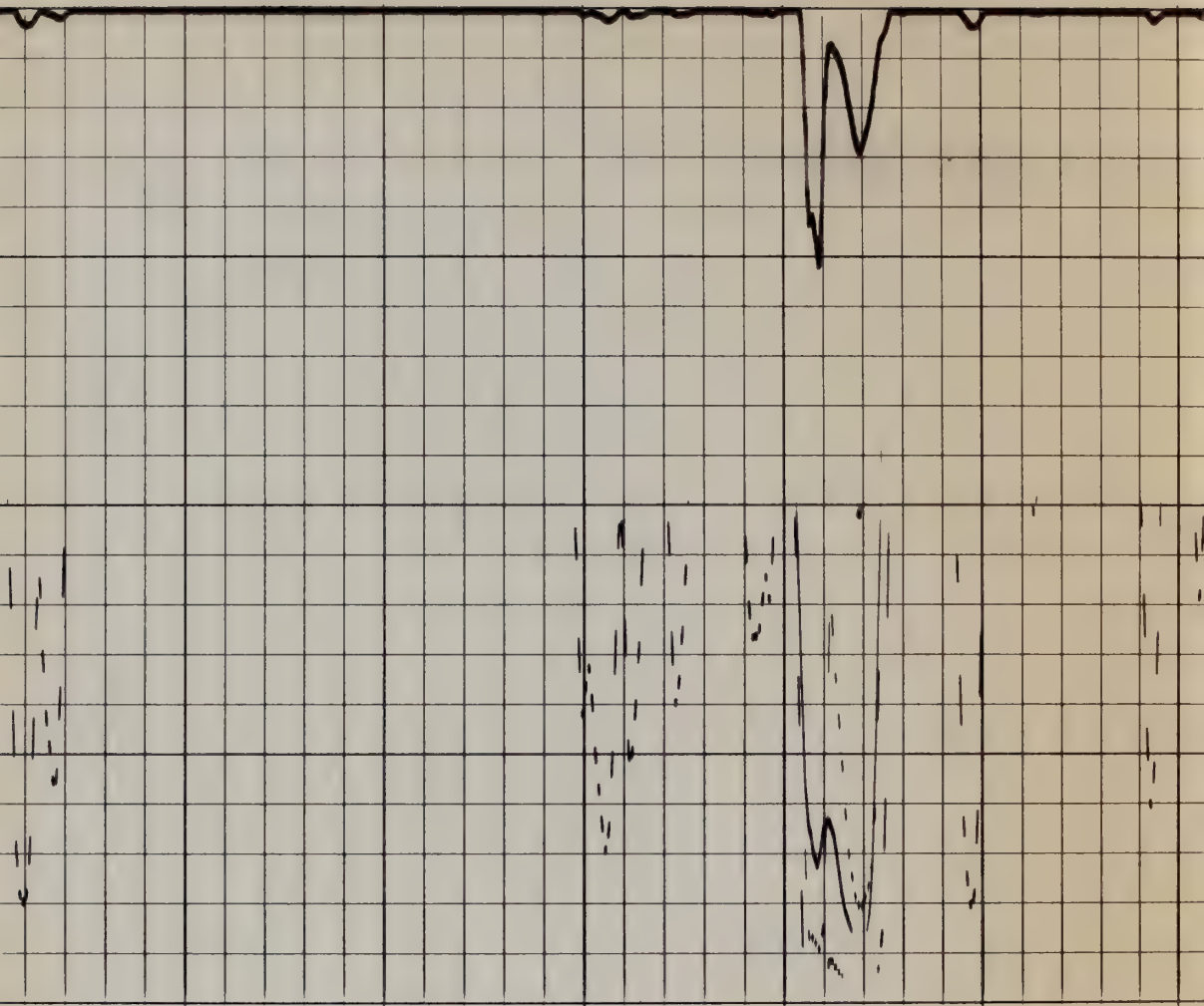
0700

0800

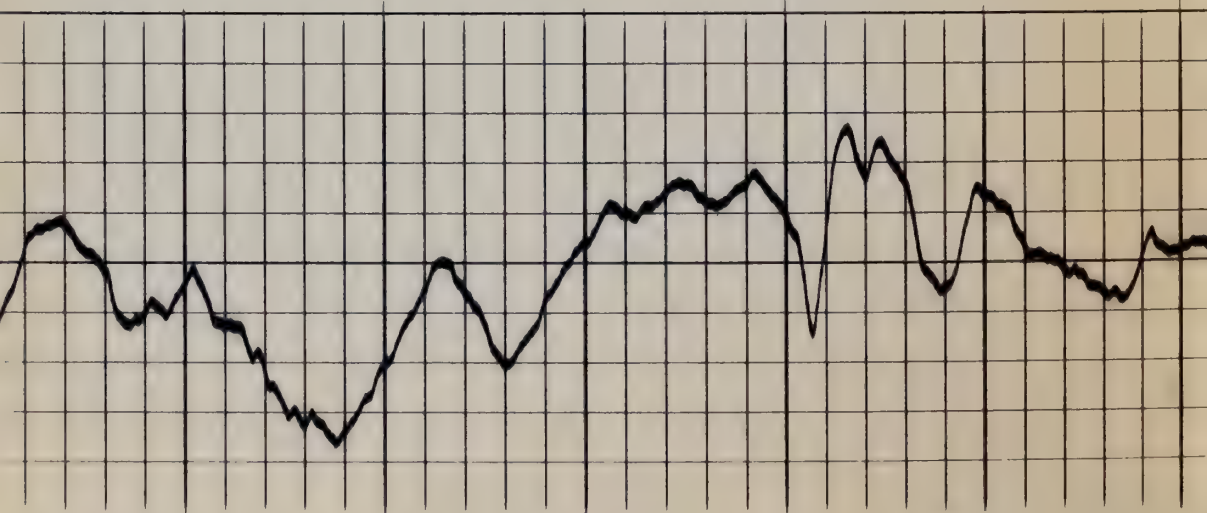
0900

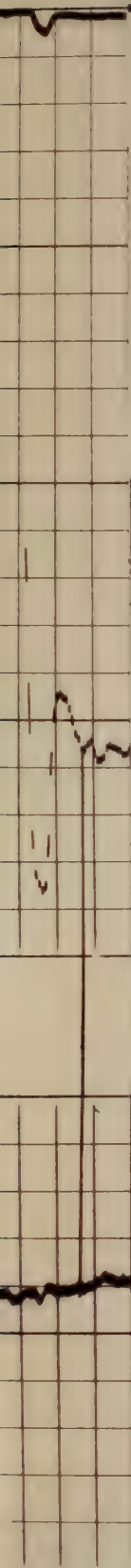






0 1400 1500 1600



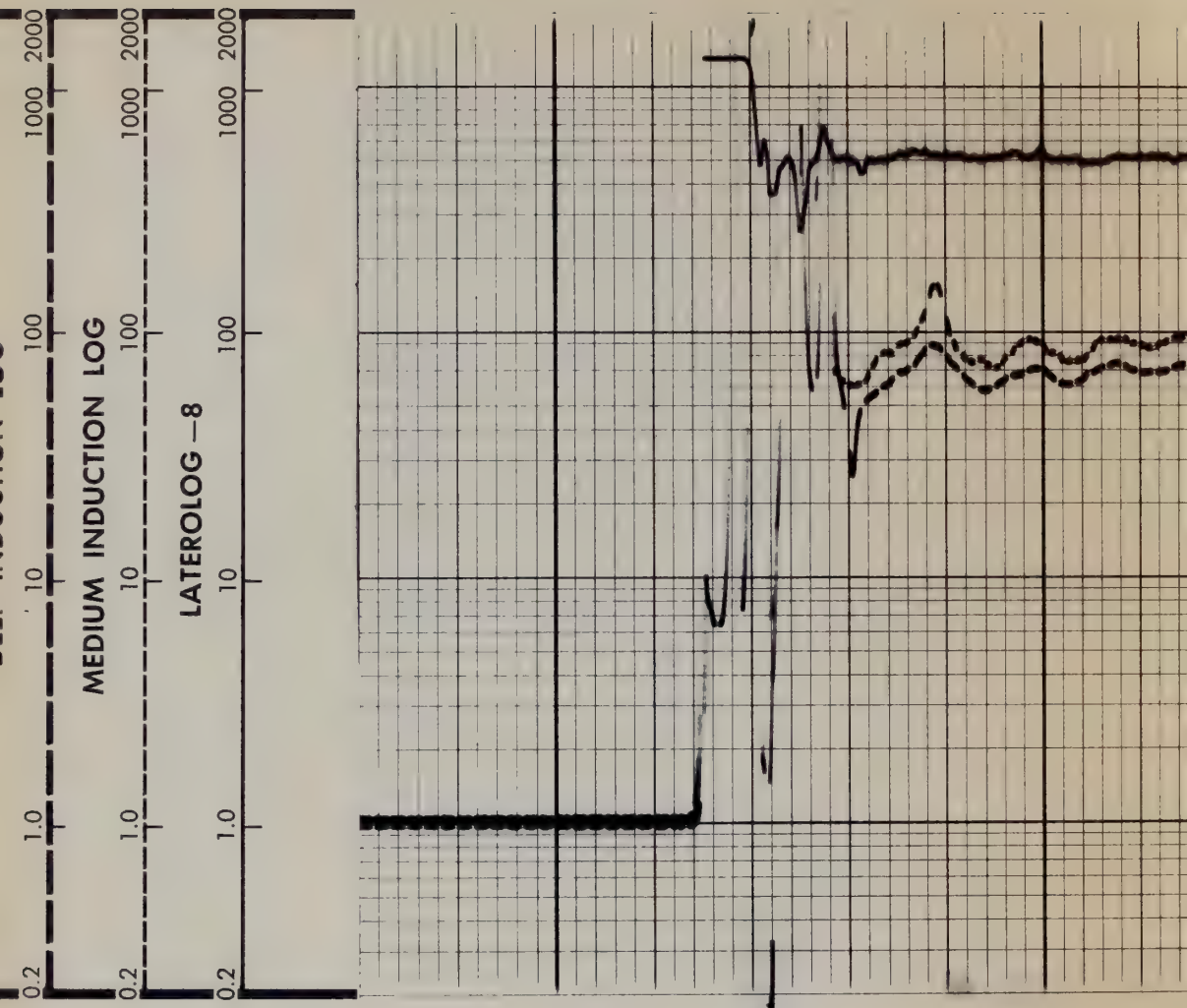


		<p>0 AVERAGED LATEROLOG — 8 100</p> <p>0 1000</p> <p>0 DEEP INDUCTION LOG 100</p> <p>0 1000</p> <p>RESISTIVITY OHMS. M²/M</p>	<p>400 200 0</p> <p>DEEP INDUCTION LOG</p>	<p>SPONTANEOUS-POTENTIAL MILLIVOLTS</p>	<p>DEPTHS</p>	<p>CONDUCTIVITY</p> <p>MILLIMHOS/M = $\frac{1000}{\text{OHMS. M}^2/\text{M}}$</p>
--	--	--	--	---	---------------	--

— | 20 | +
↔ MV

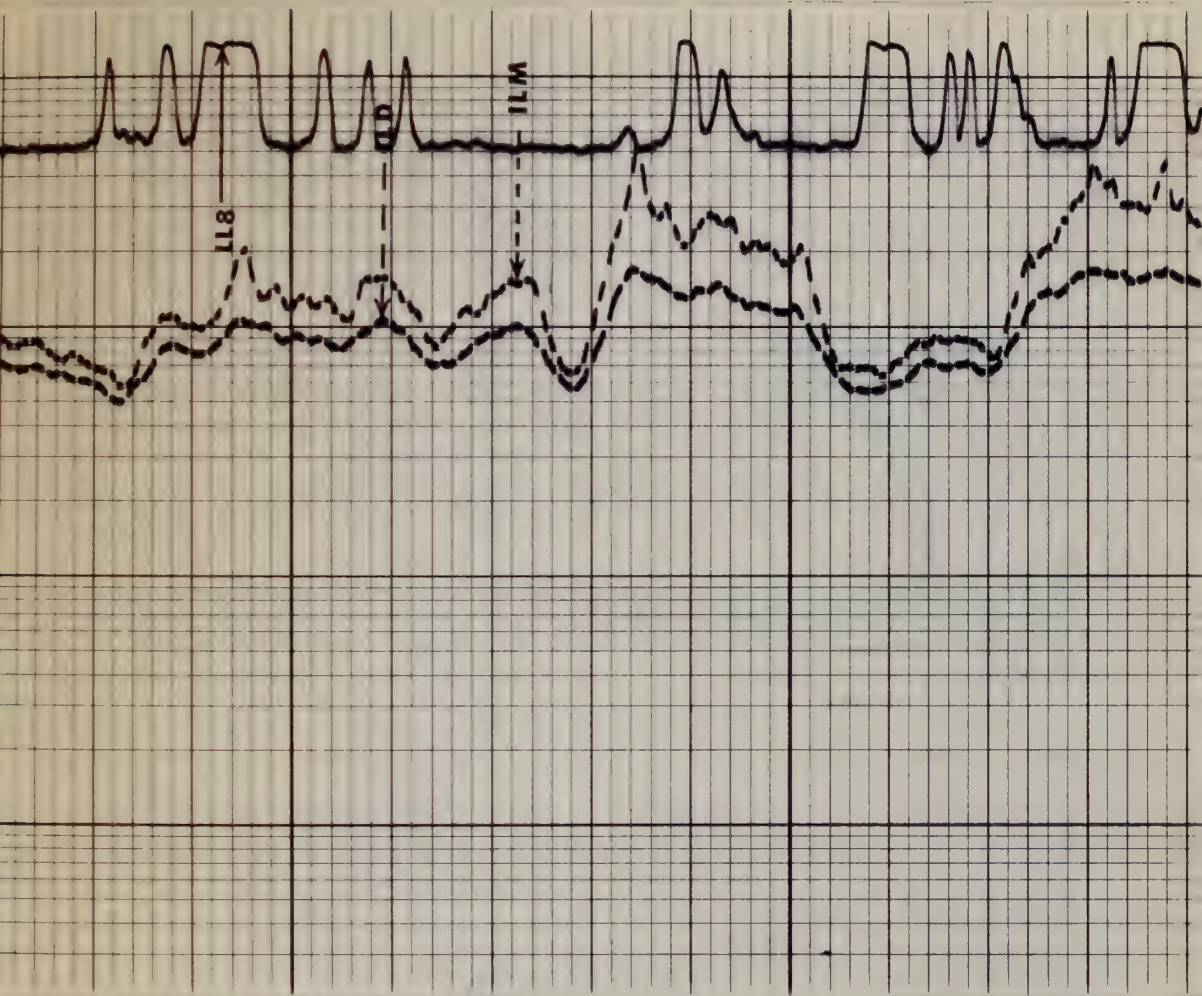
		<p>DETAIL LOG</p> <p>5" = 100'</p>	<p>SPONTANEOUS-POTENTIAL MILLIVOLTS</p>	<p>DEPTHS</p>	<p>RESISTIVITY OHMS. M²/M</p>	<p>DEEP INDUCTION LOG</p>
--	--	------------------------------------	---	---------------	--	---------------------------

— $\left| \begin{array}{c} 20 \\ \longleftrightarrow \\ \text{mV} \end{array} \right|$ +

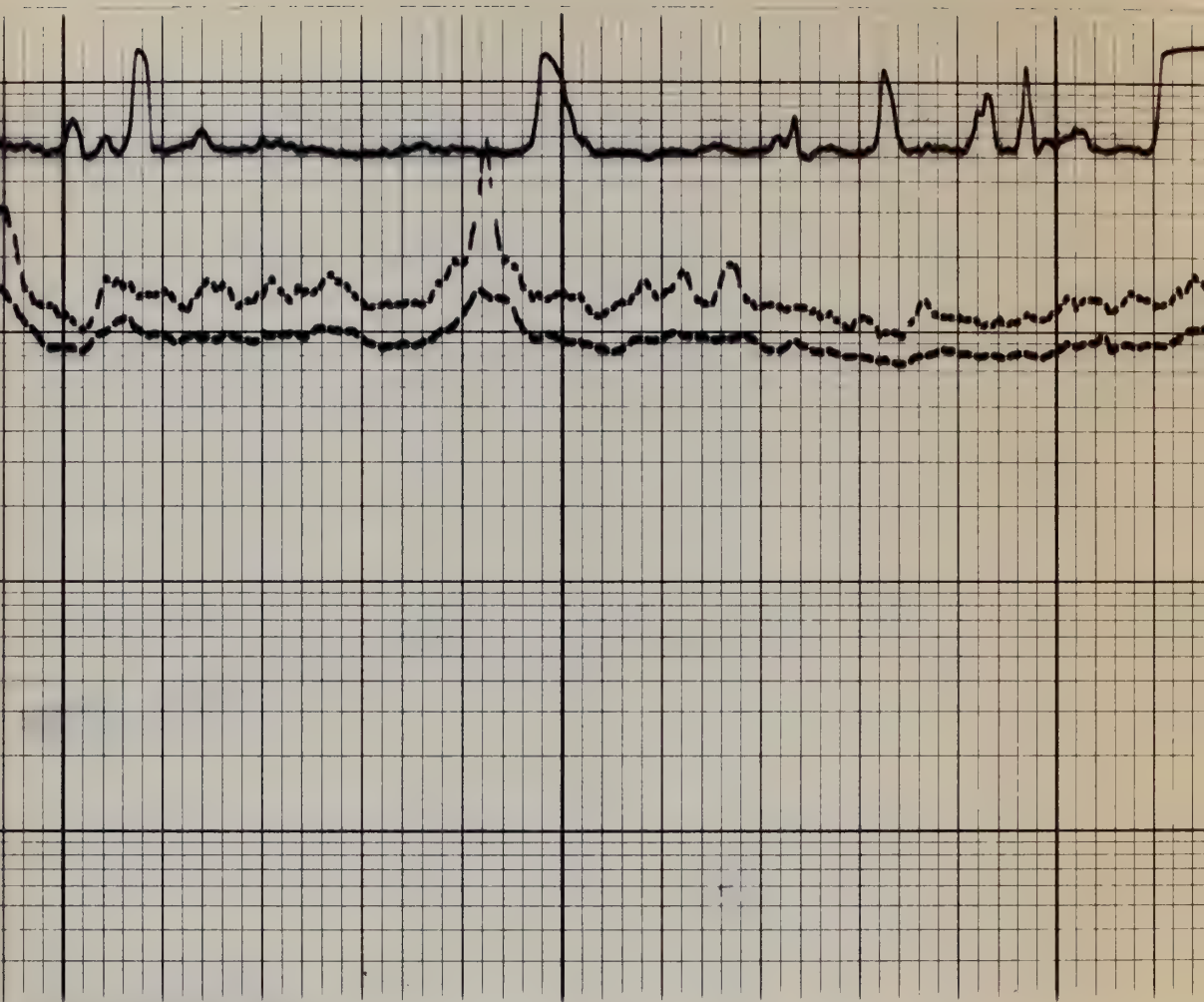


Casing

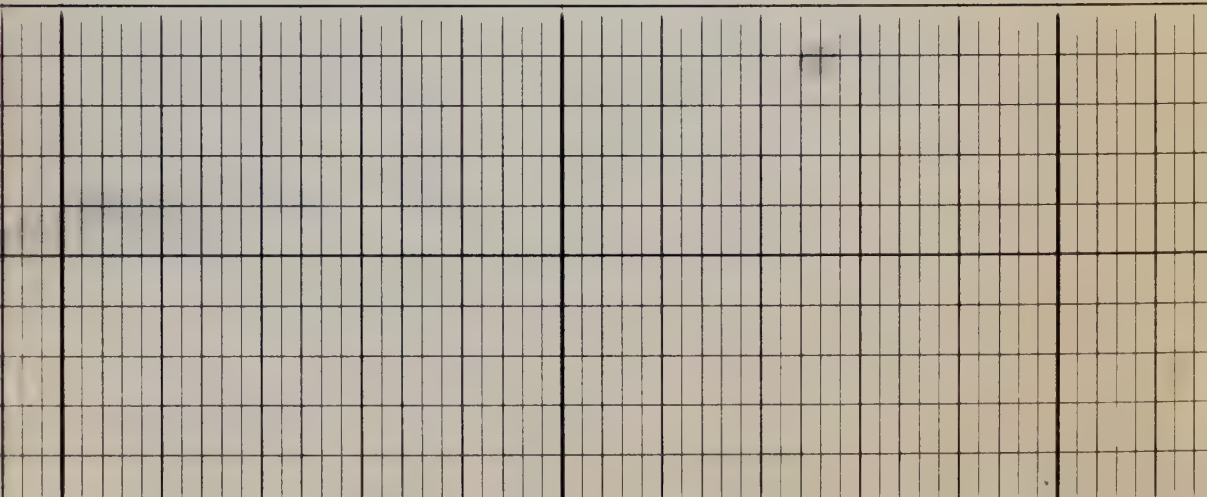
0100



0200

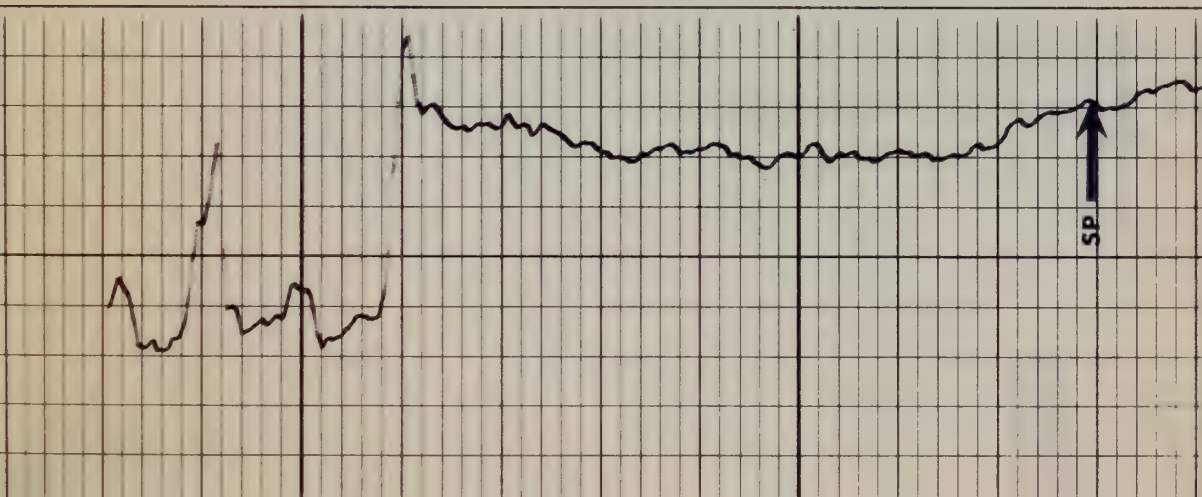


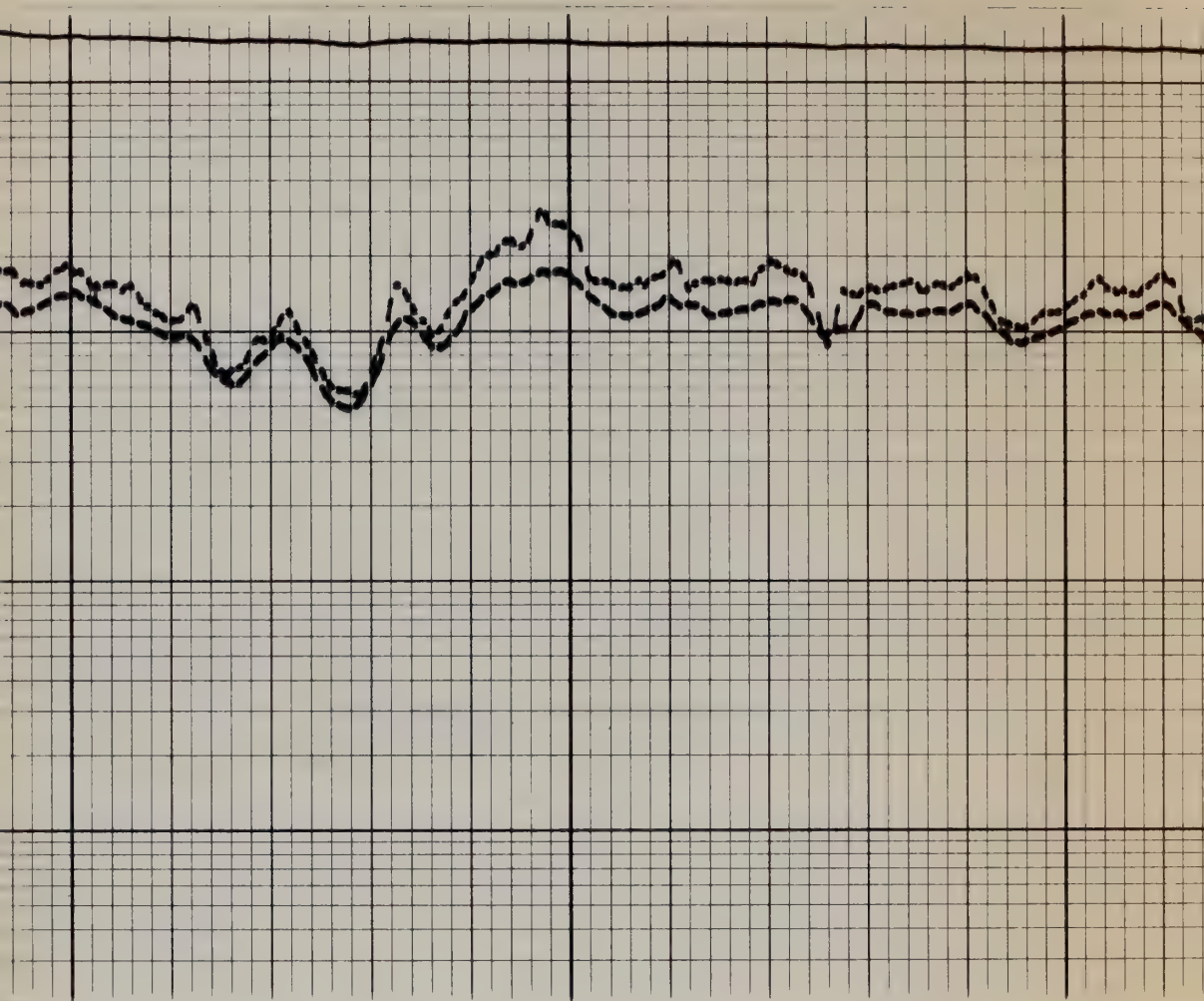
0300





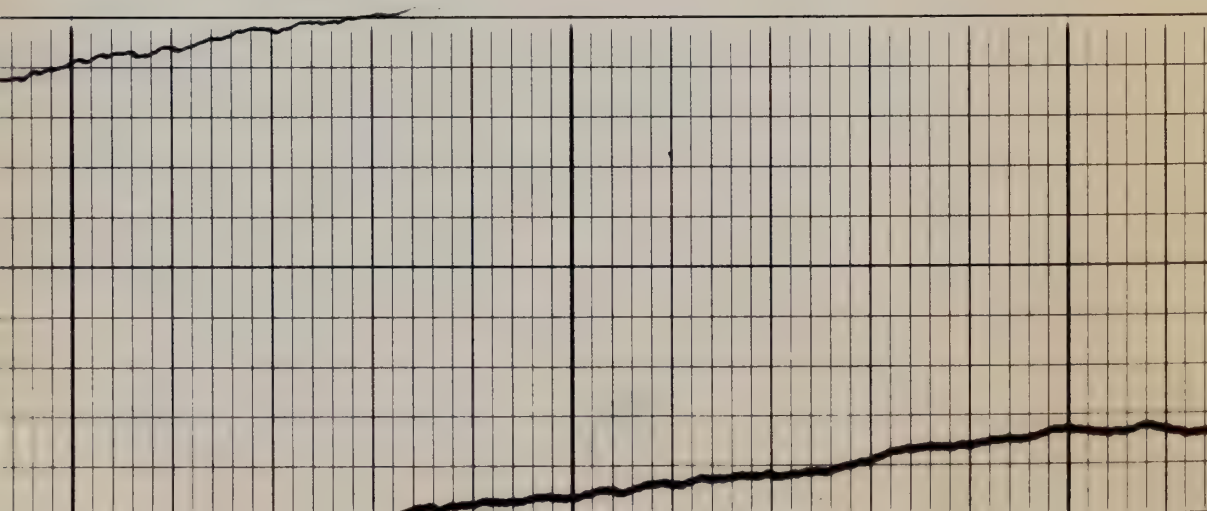
0400

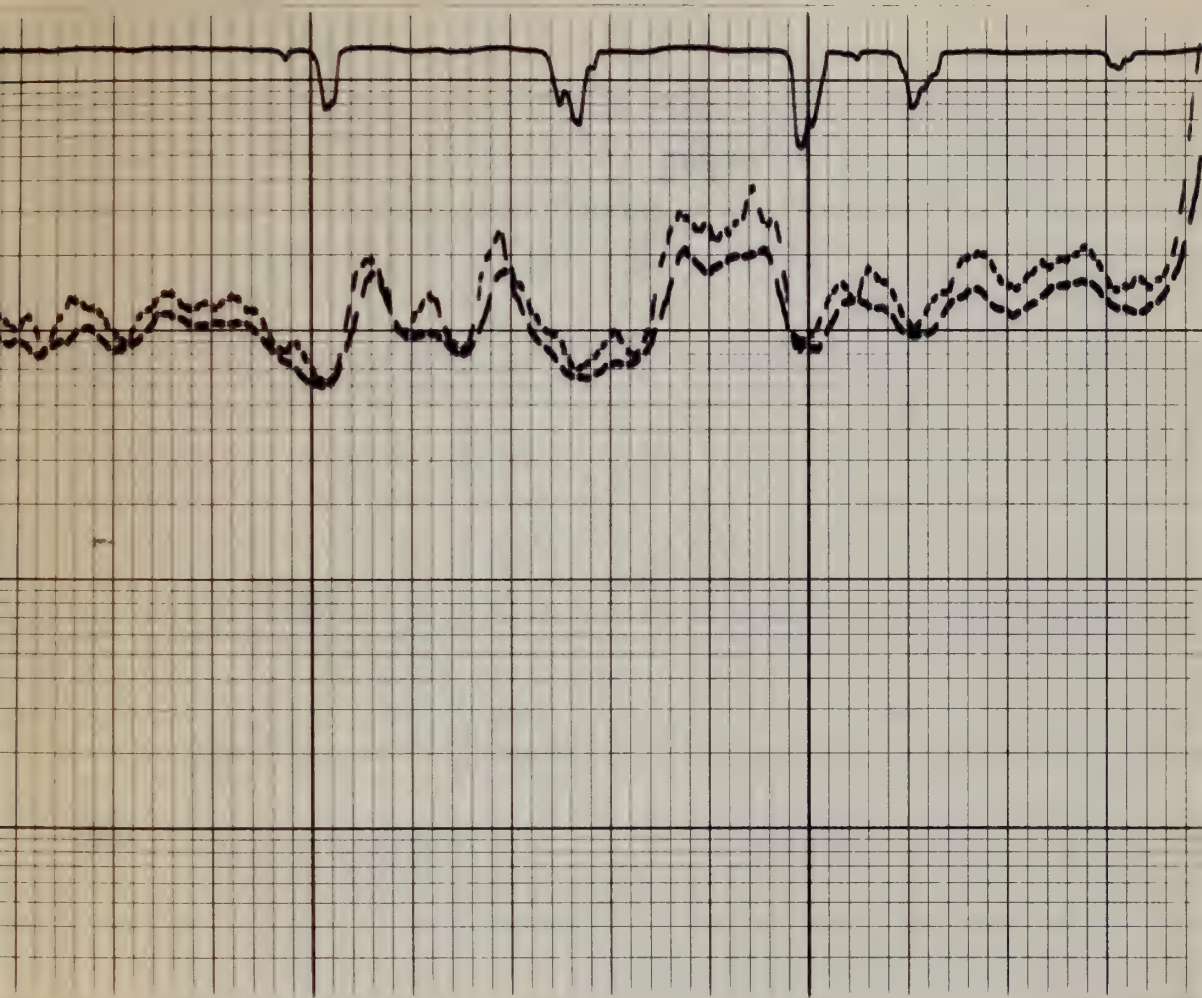




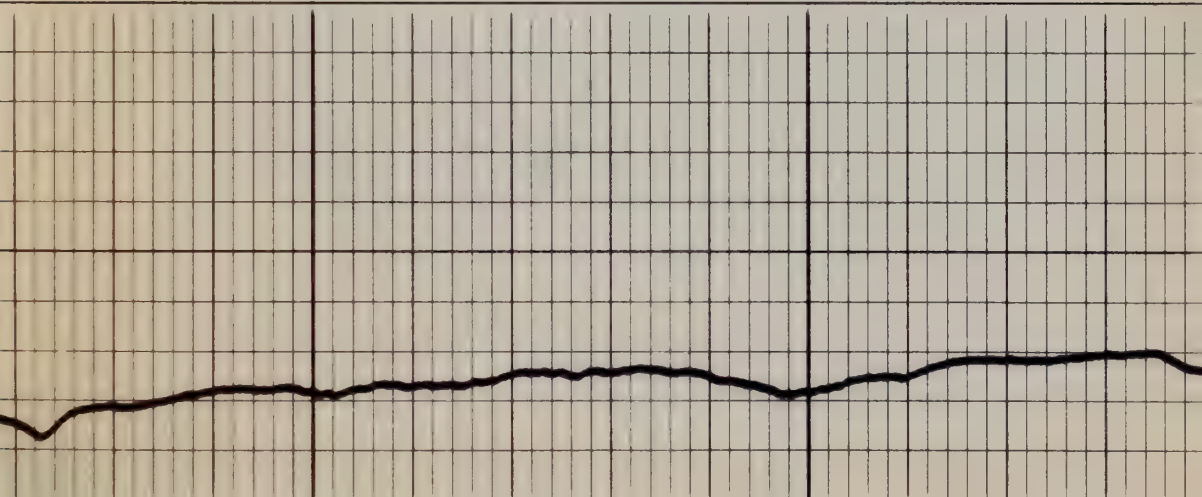
0500

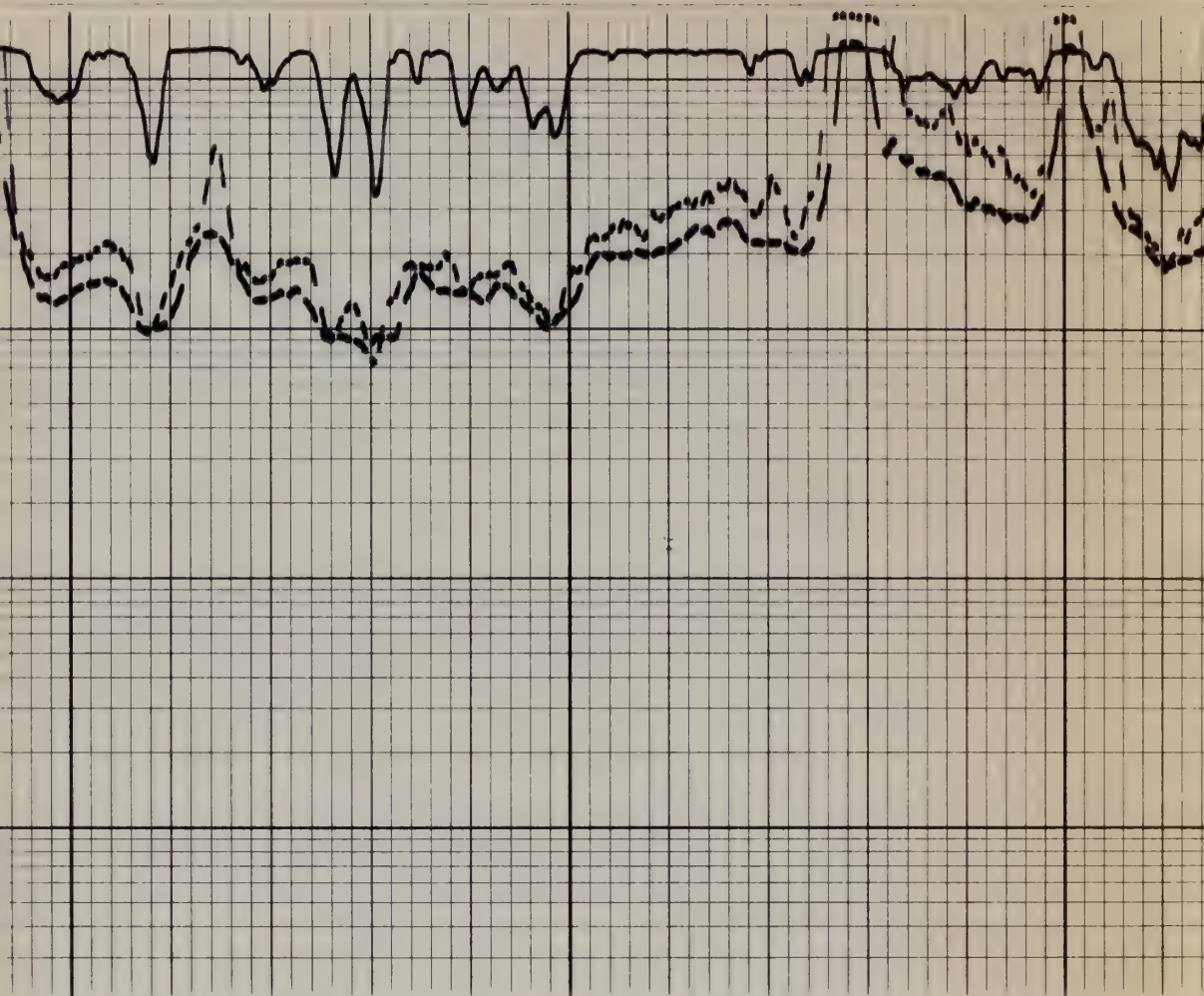
0600



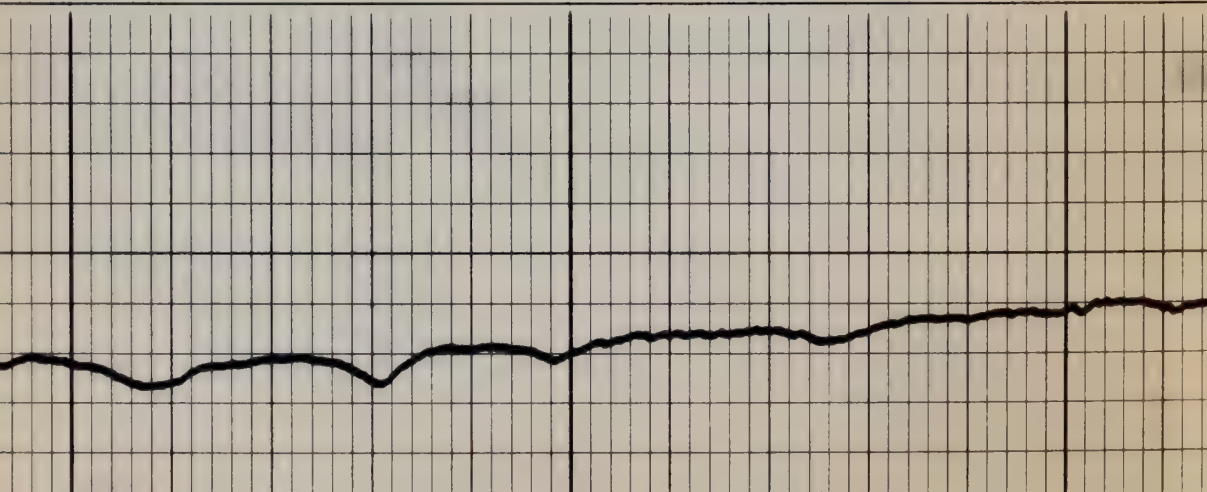


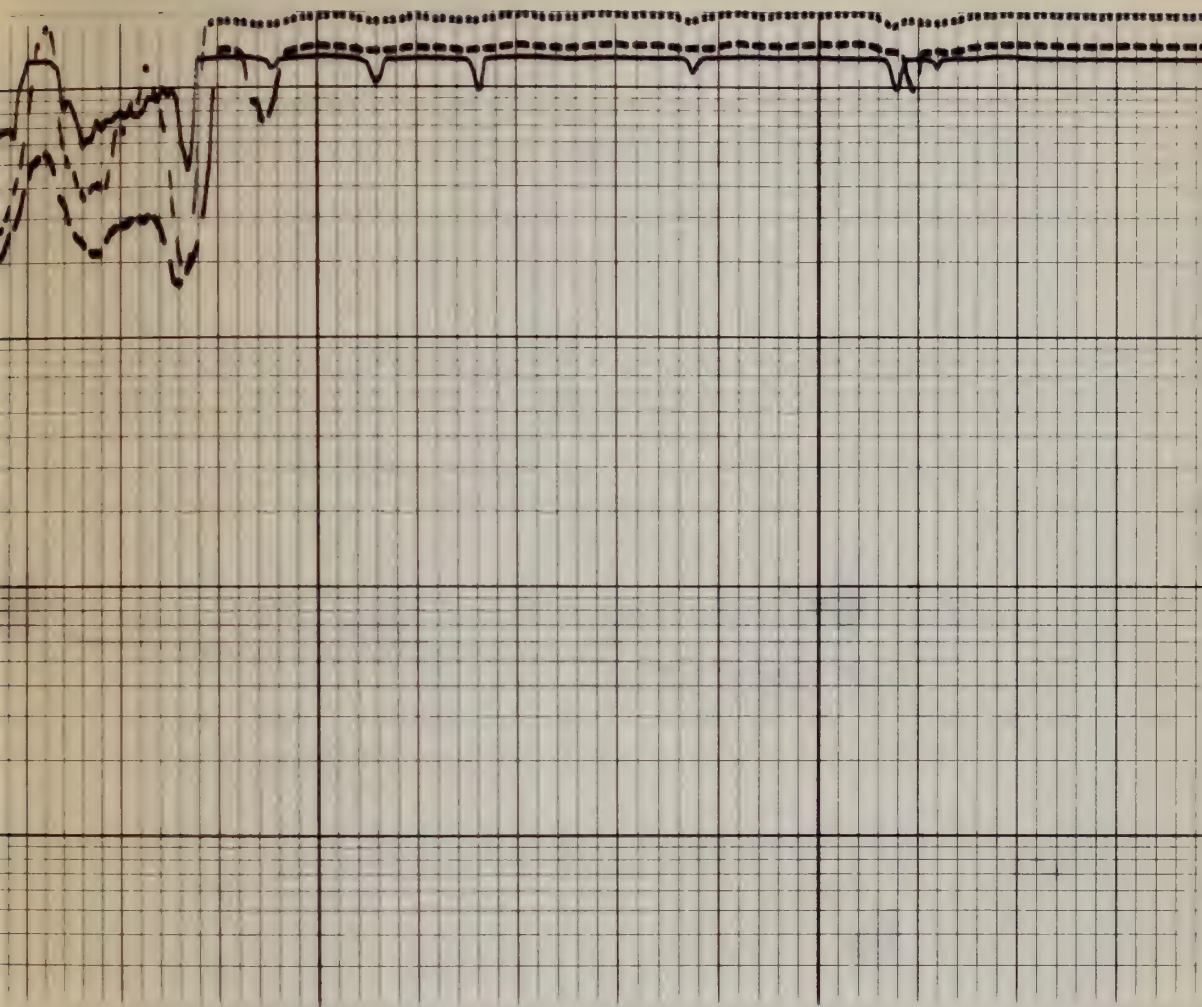
0700



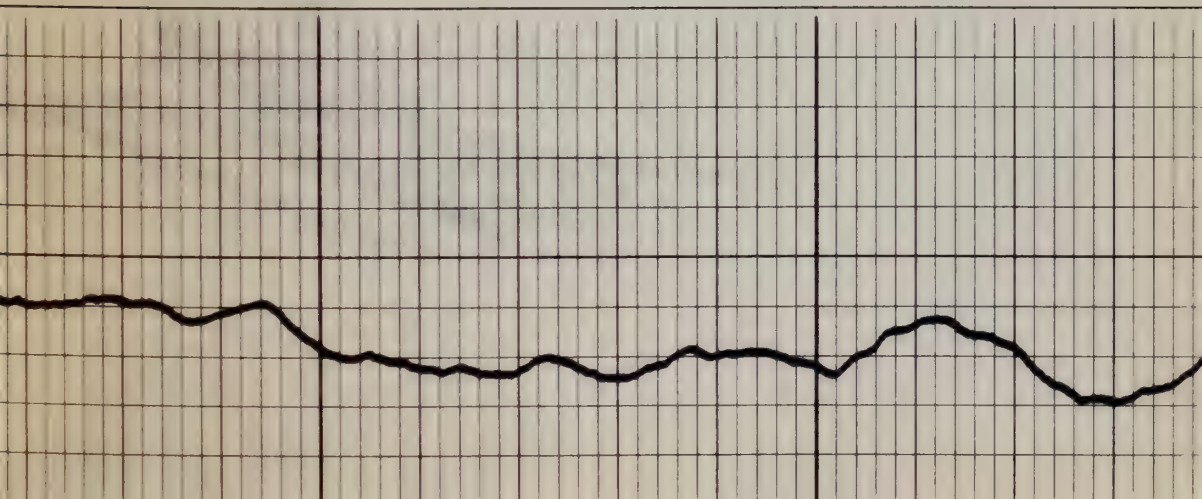


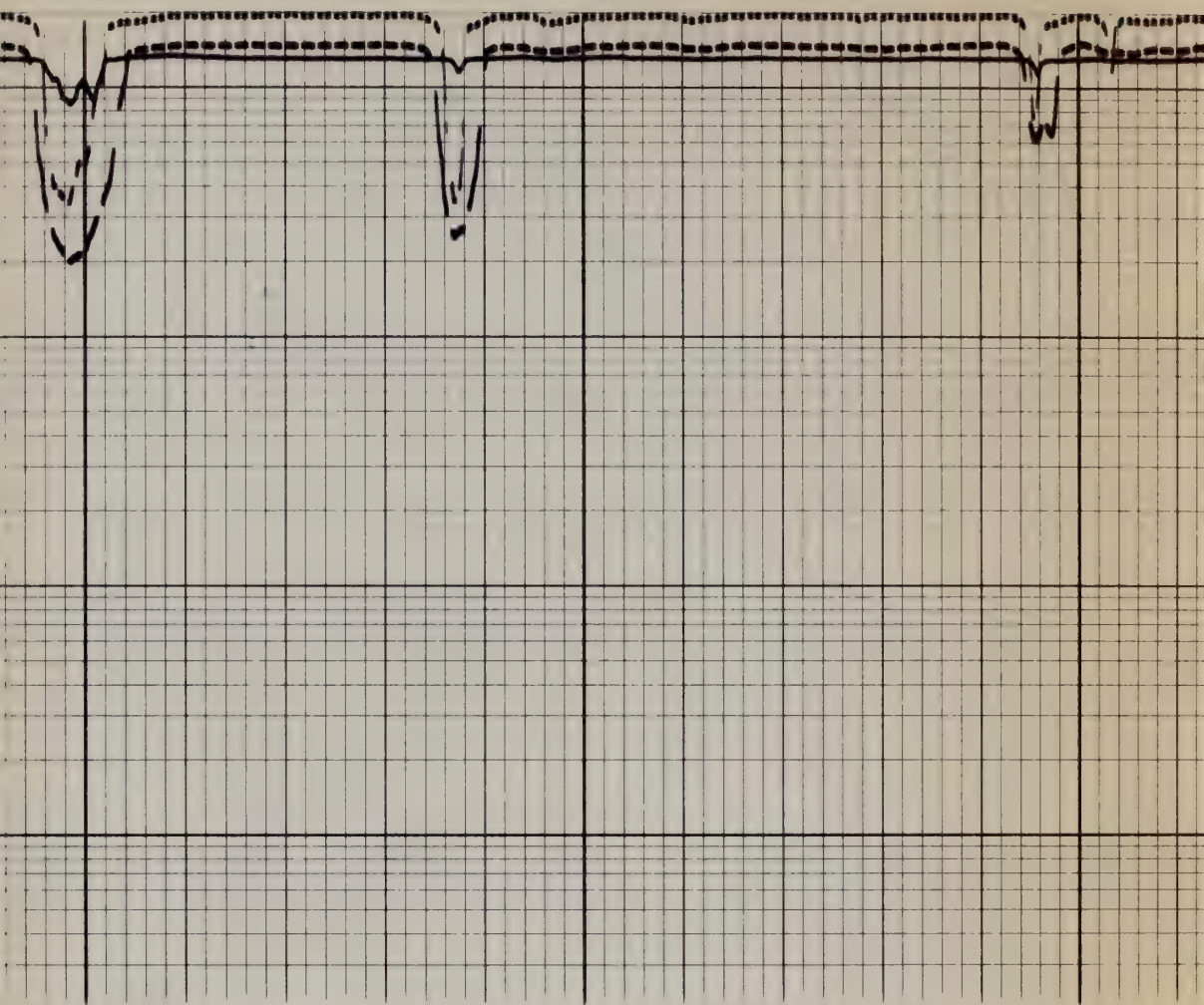
0800





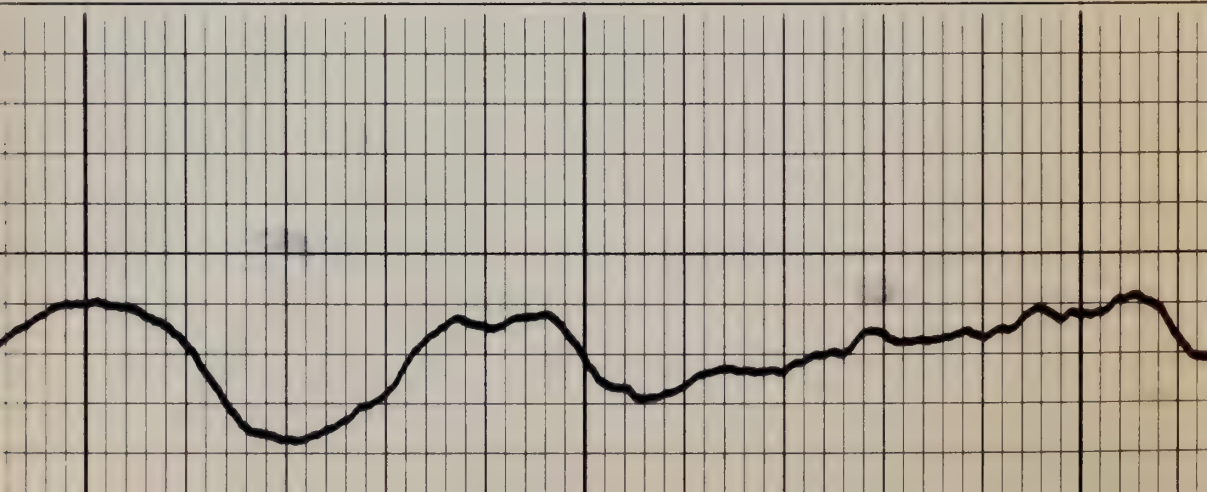
0900

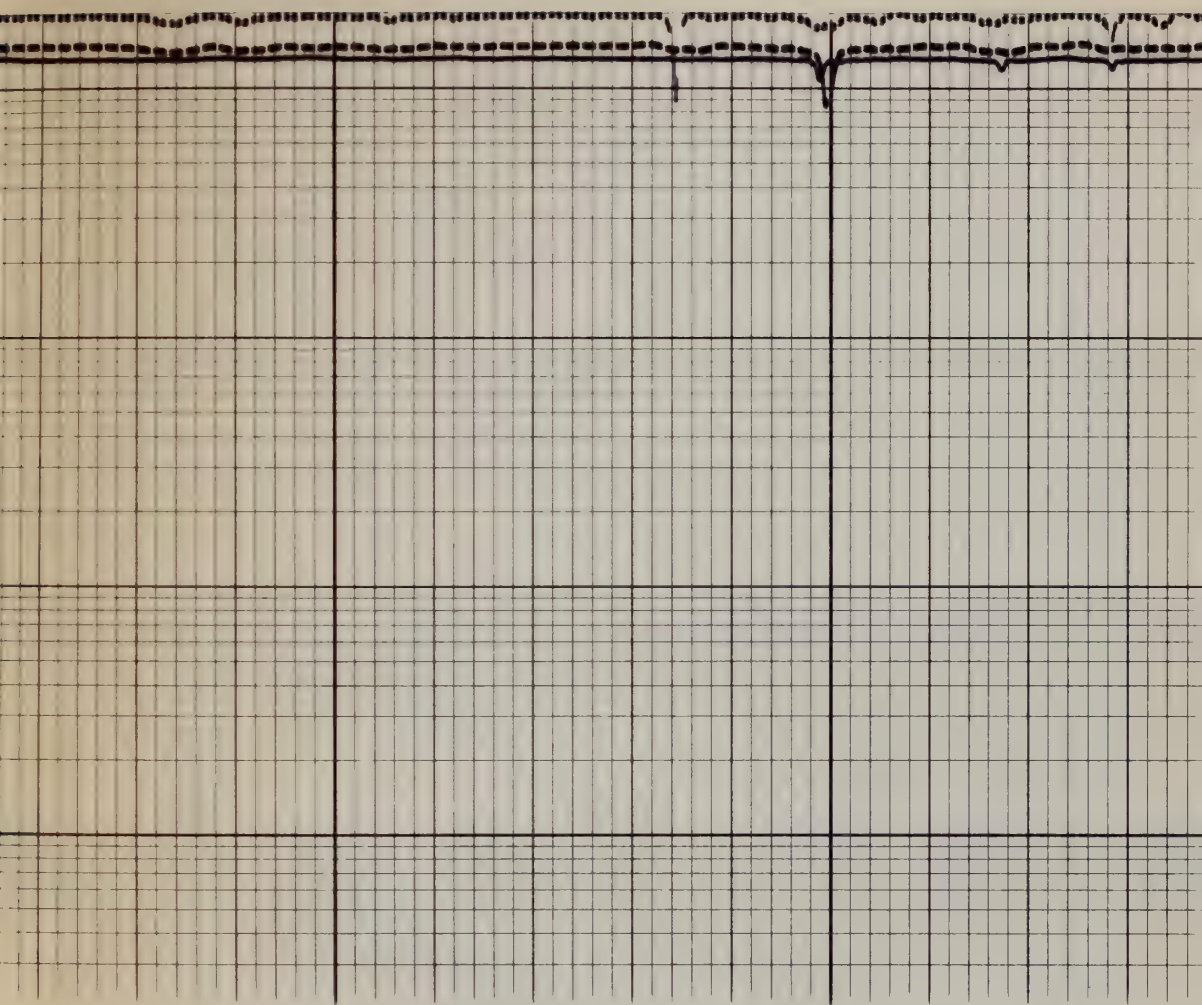




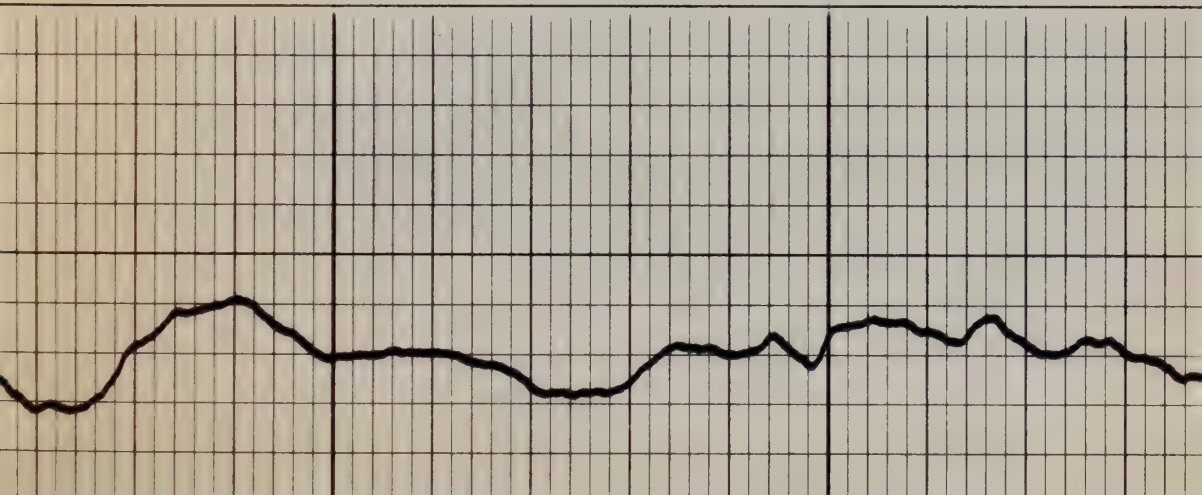
1000

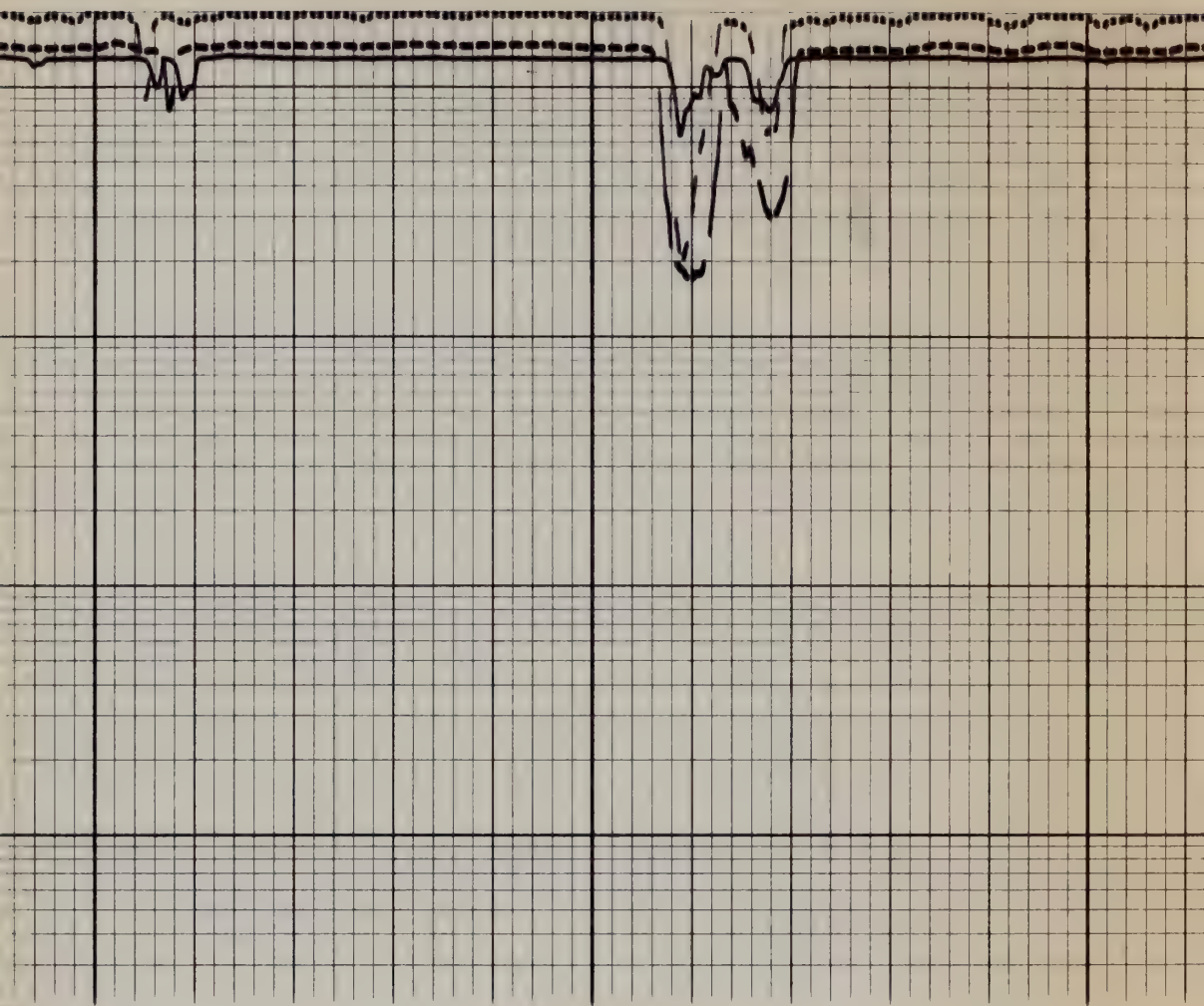
1100



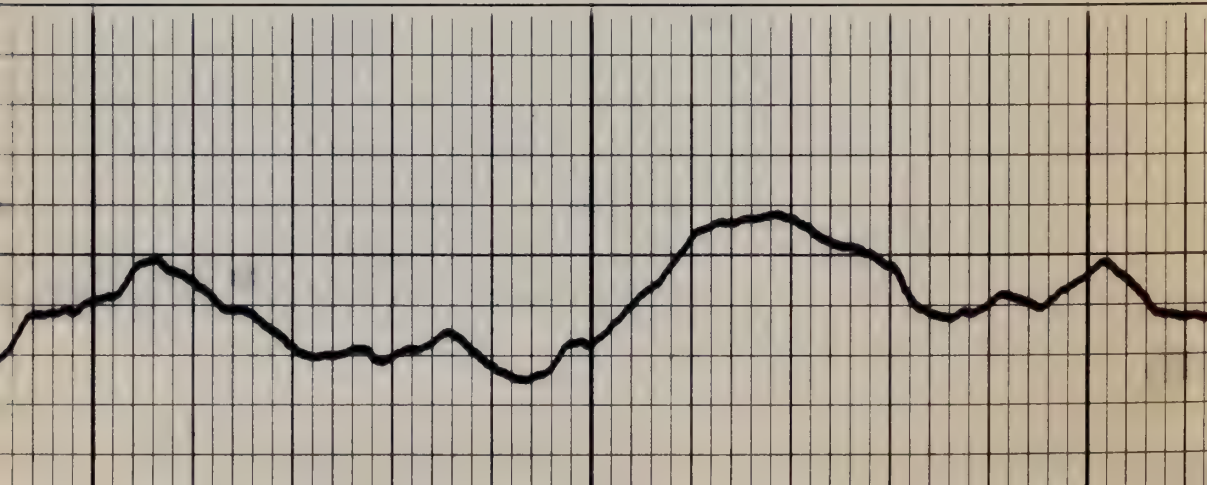


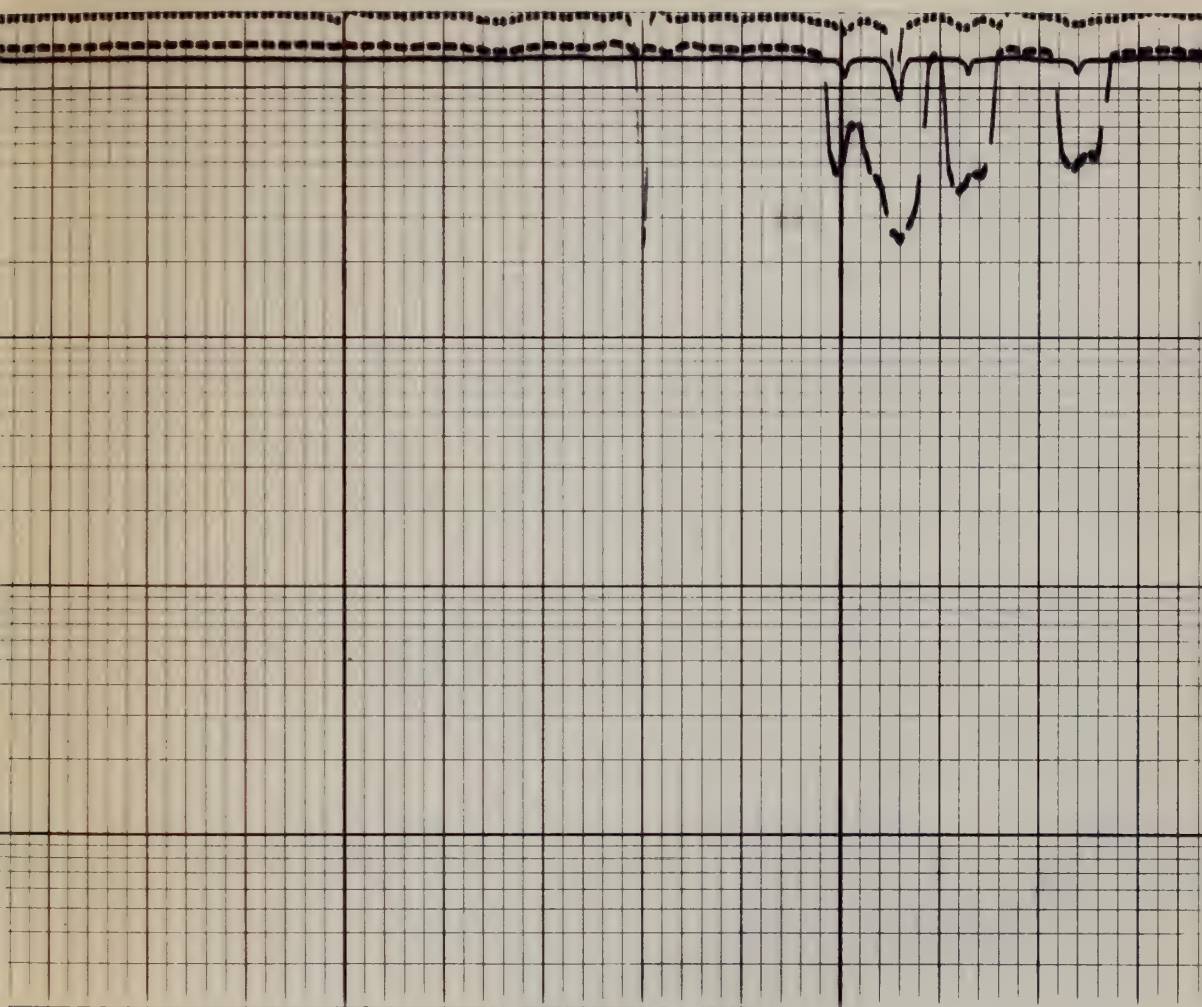
1200



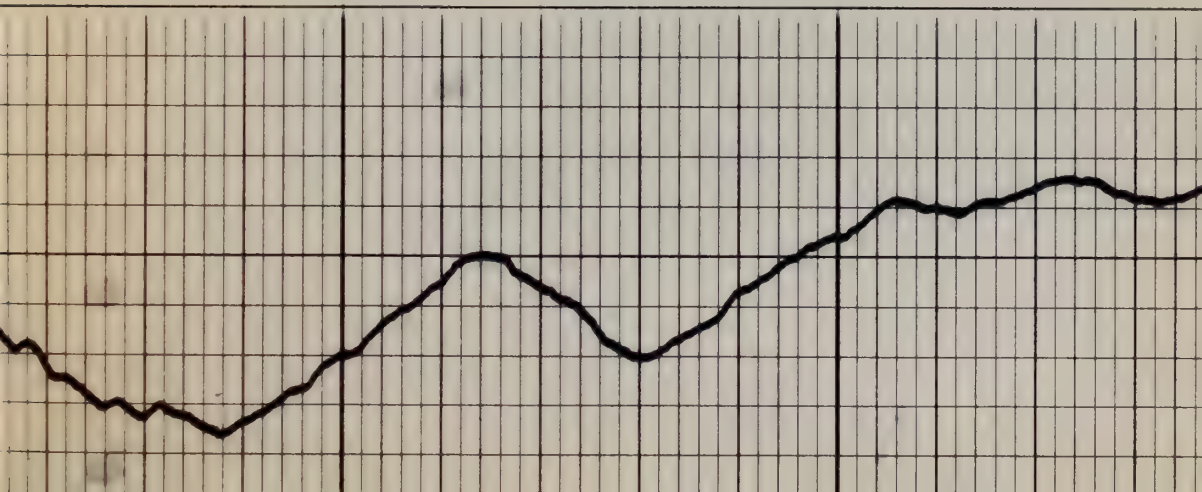


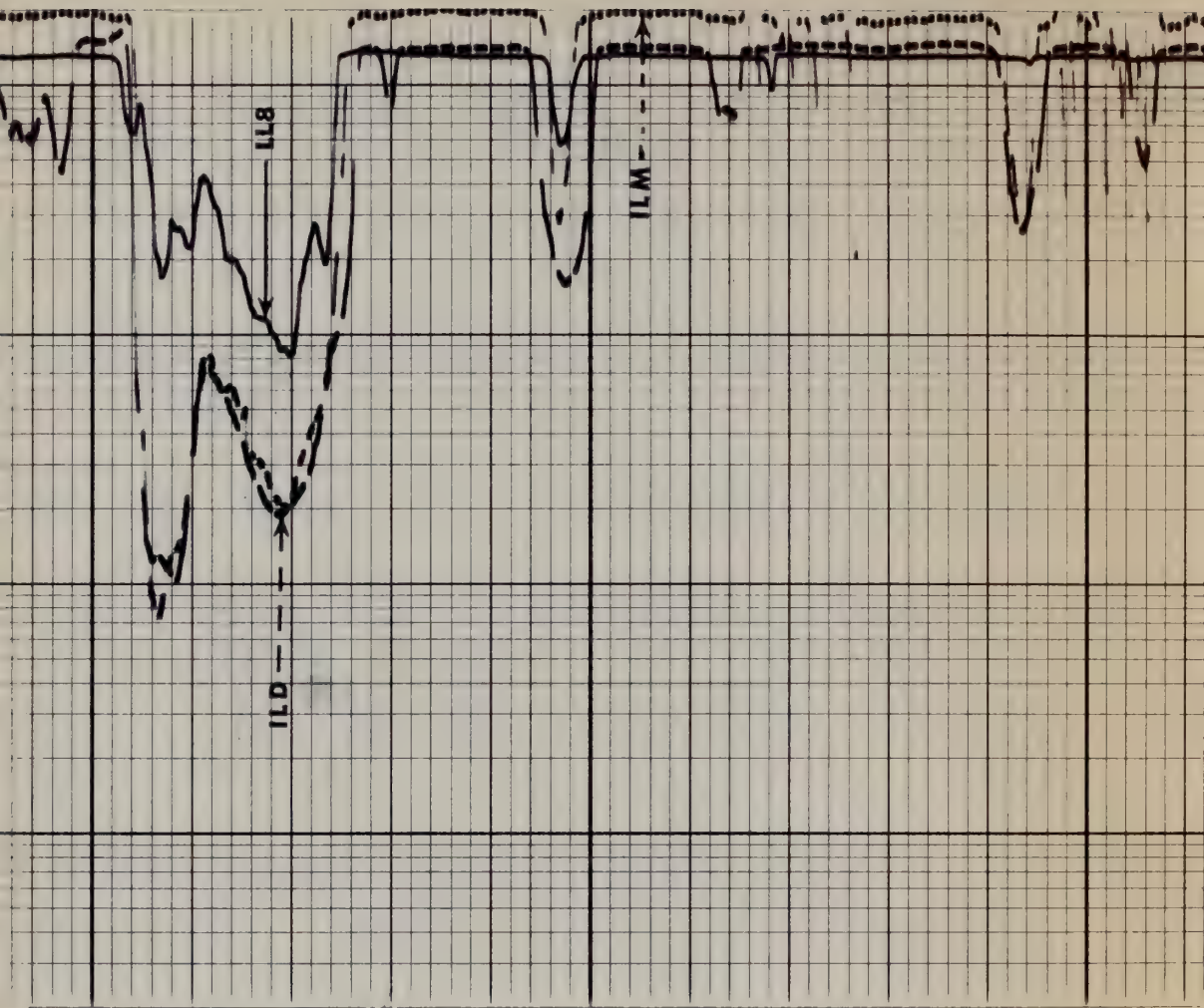
1300





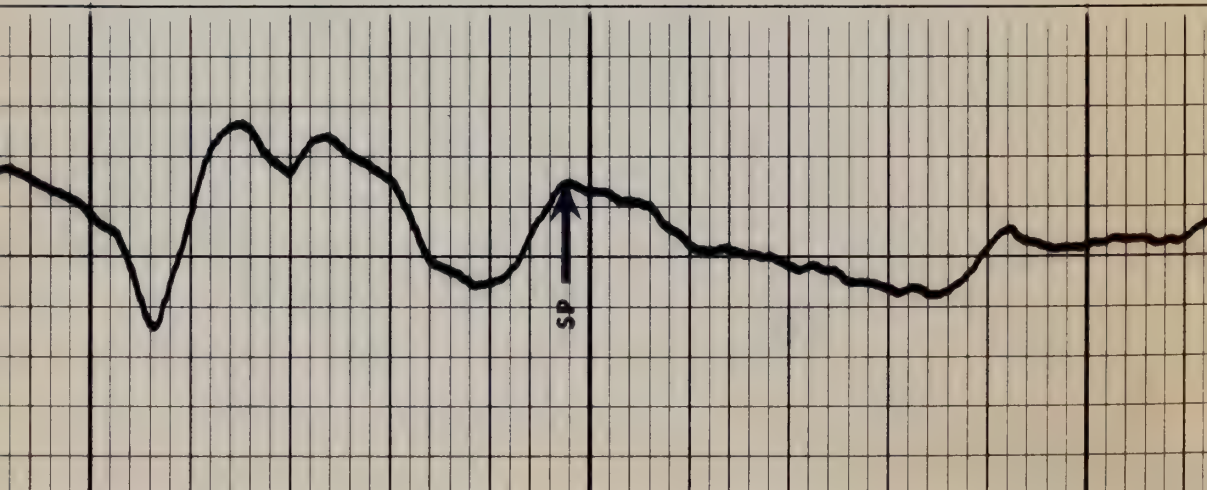
1400

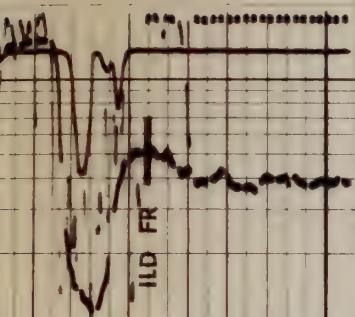




1500

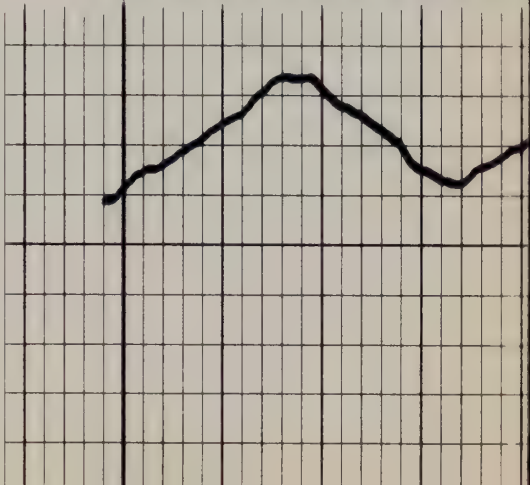
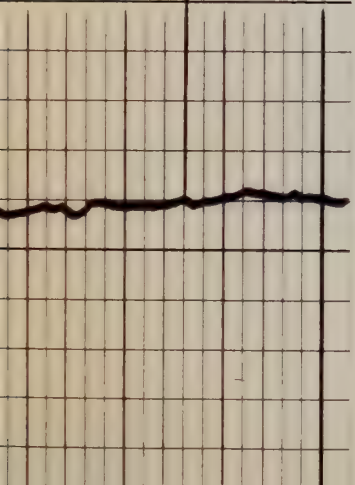
1600

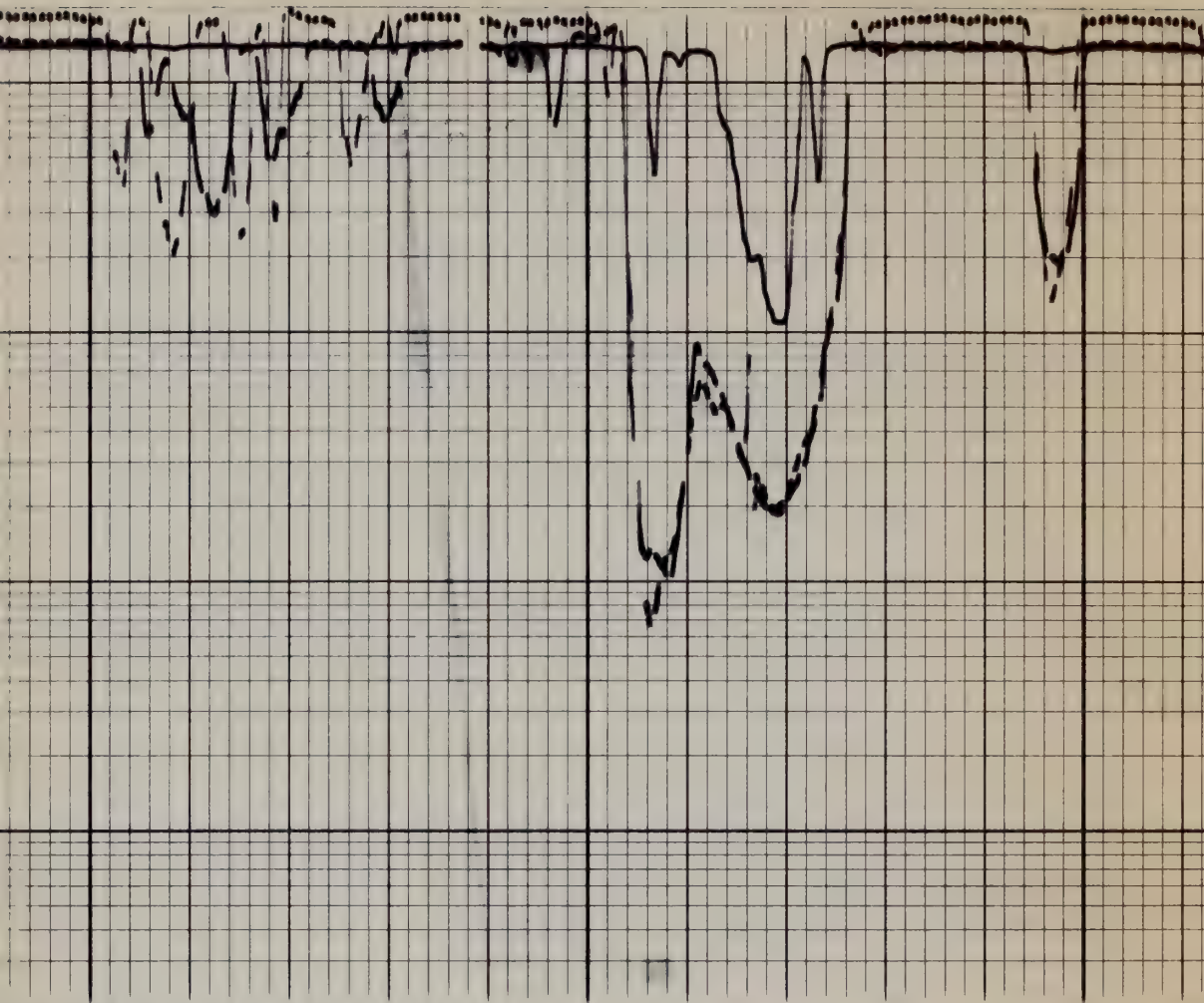




REPEAT SECTION

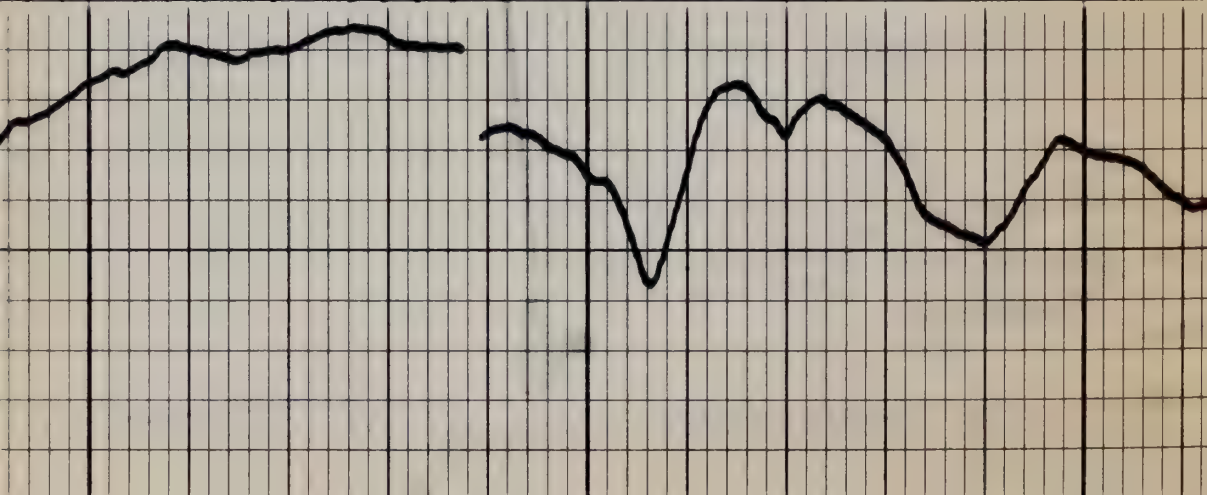
1400 MEMORIZER OUT — CU

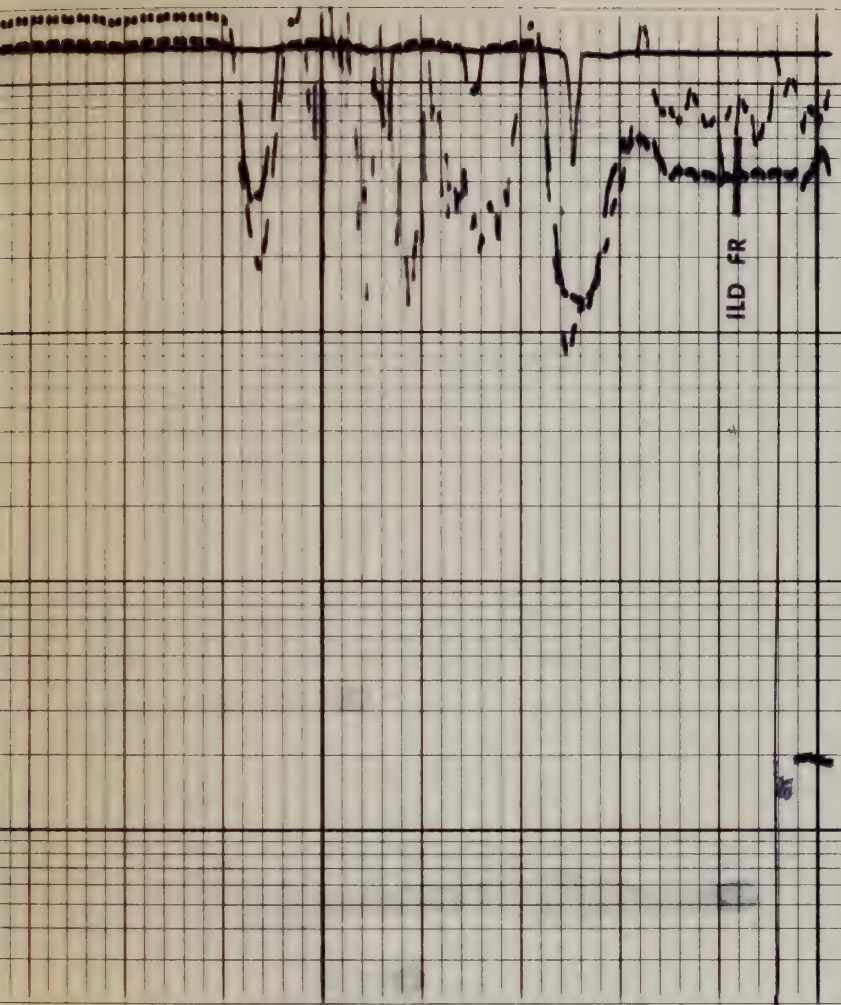




RVES INVALID

1500



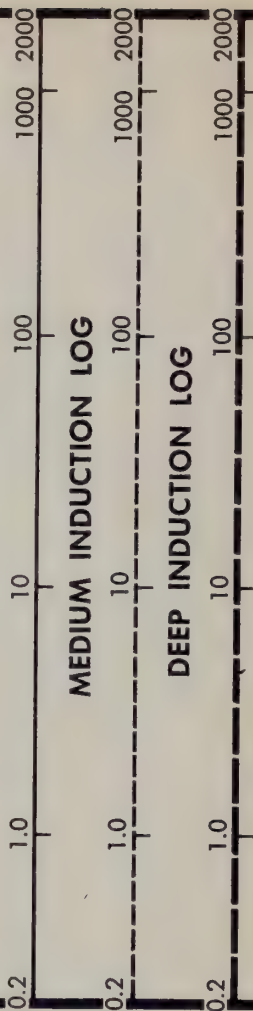


1600

LATEROLOG - 8

MEDIUM INDUCTION LOG

DEEP INDUCTION LOG



$$- \left| \frac{20}{M} \right| +$$

SPONTANEOUS-POTENTIAL

MILLIVOLTS

DEPTHS

RESISTIVITY

OHMS. M²/M

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

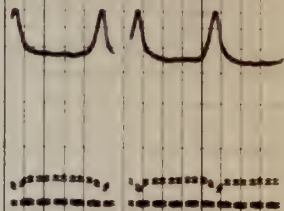
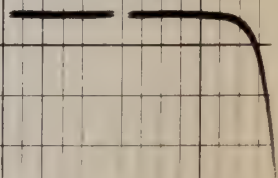
SCHL. FR 1636
SCHL. TD 1640
DRLR TD 1638

Elev: KB ----
DF ----
GL 6909

CALIBRATION RECORD

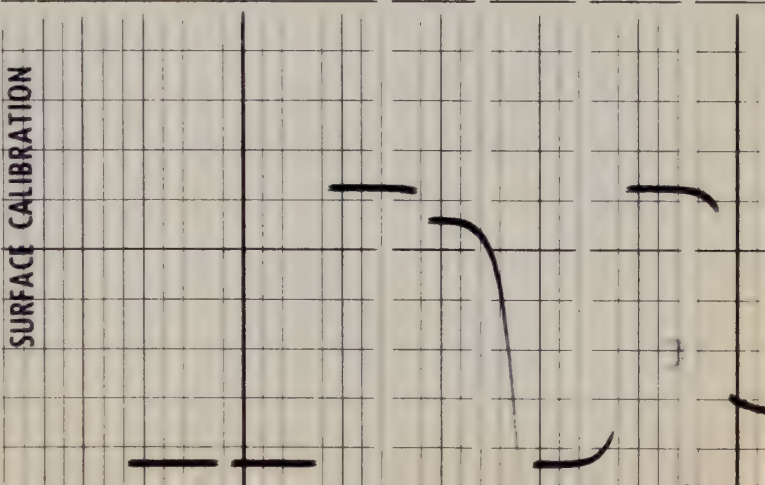
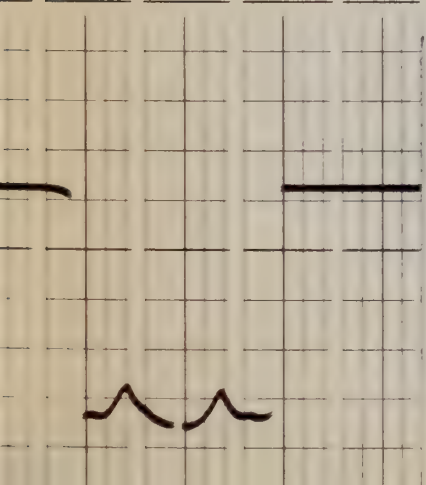
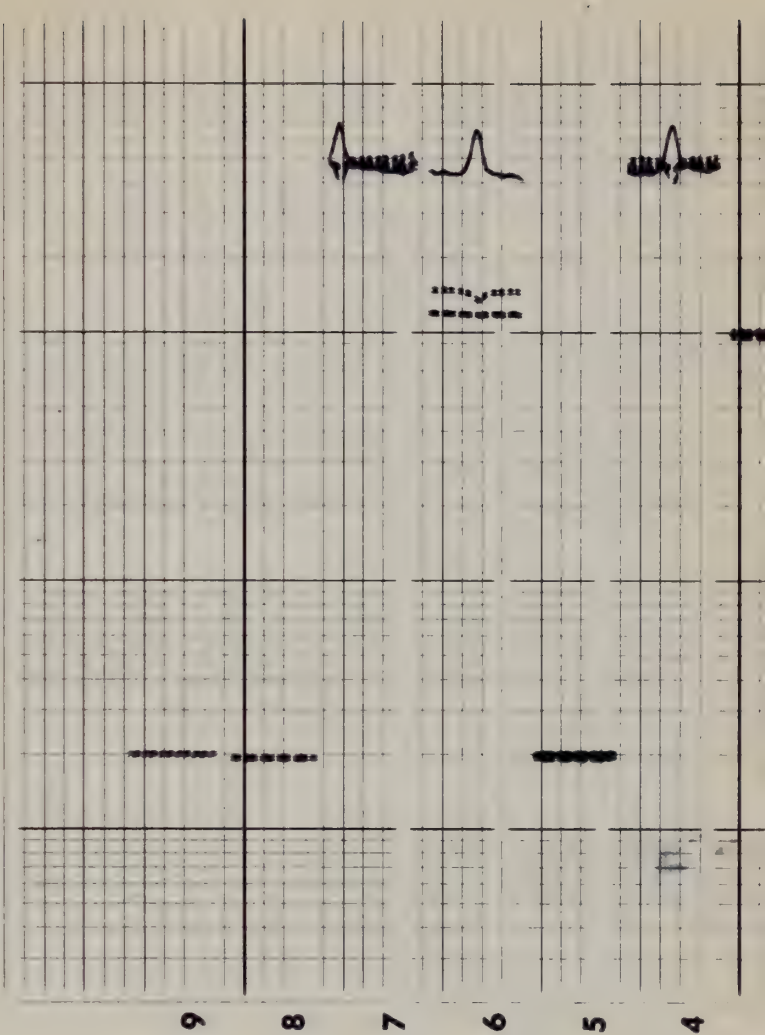
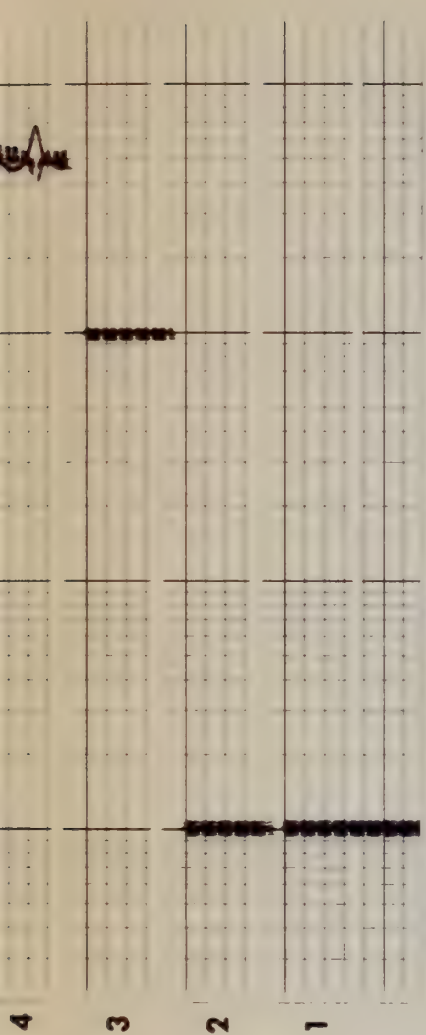


Calibration after Survey

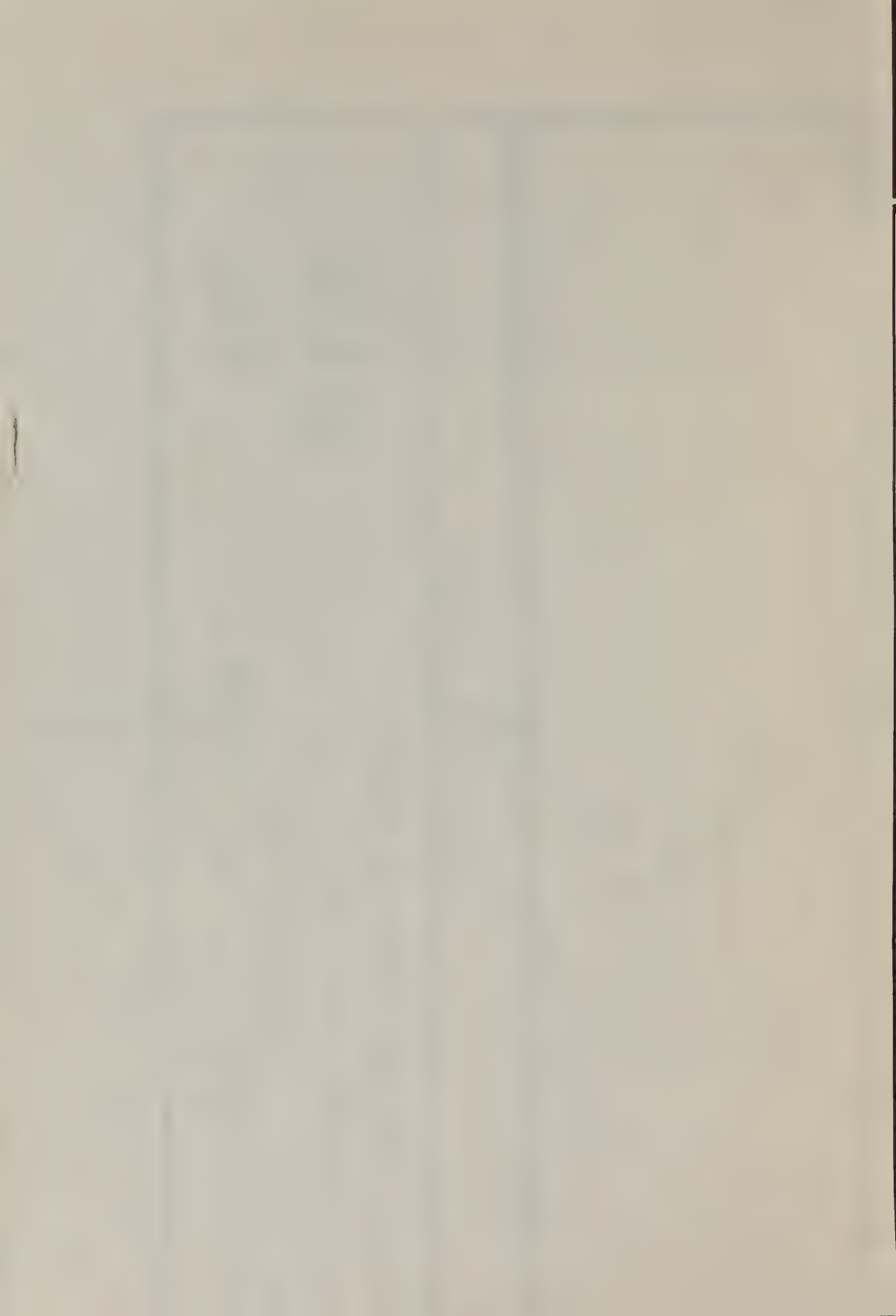


6

5



SURFACE CALIBRATION



Schlumberger

COMPENSATED FORMATION DENSITY LOG

Gamma-Gamma

COUNTY **RIO BLANCO**
FIELD or LOCATION
WELL **AQUIFER TEST NO. 1-B**
COMPANY **ATLANTIC RICHFIELD**

COMPANY **THE ATLANTIC RICHFIELD COMPANY**WELL **AQUIFER TEST NO. 1-B**FIELD **----**COUNTY **RIO BLANCO** STATE **COLORADO**Location: API Serial No. **01036**

Other Services:

DIL ENG. PRO**CNL-GR****BHC-GR**Sec. **7** Twp. **3S** Rge. **96W**

Permanent Datum: **GL** ; Elev.: **6909**
Log Measured From **GL** , **0** Ft. Above Perm. Datum
Drilling Measured From **GL**

Elev.: K.B. **----**D.F. **----**G.L. **6909**

Date	7-21-74			
Run No.	ONE			
Depth—Driller	1638			
Depth—Logger	1641			
Btm. Log Interval	1640			
Top Log Interval	72			
Casing—Driller	8-5/8@ 60	@	@	@
Casing—Logger	72			
Bit Size	7-7/8			
Type Fluid in Hole	WATER			
Fluid Level	410			
Dens.	8.3	----		
Visc.				
pH	---	-- ml	ml	ml
Fluid Los				
Source of Sample				
Rm @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmf @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Rmc @ Meas. Temp.	@ °F	@ °F	@ °F	@ °F
Source: Rmf				
Rmc				
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.	26 HRS.			
Max. Rec. Temp.	90 °F	°F	°F	°F
Equip.	5602	G.J.		
Location				
Recorded By	SCHNORR			
Witnessed By	TAIT			

CHANGES IN MUD TYPE OR ADDITIONAL SAMPLES

[illegible]

EQUIPMENT DATA

Run No.	ONE
Panel No.	EA-169
Cart No.	EA-289
Skid No.	E-90
Sonde No.	P-436
Source	3098
Calibrator	210
GR Cart.	KG-311
TTR	----
Mem Panel	B-250

BIT SIZE, CASING DATA

Bit	From	To	Csg. Size	Csg. Wt.	From	To
7-	1638	60	3-5/8		60	GL
7/8						

SCALE CHANGES

[illegible]

LOGGING DATA

FDC Selectors					
Liquid Density	Grain Density	Hole Fluid	Porosity Scale	From	To
1.00	2.71	WATER	30/TK	1640	410
.82	2.71	AIR	30/TK	410	72

REMARKS

Service Order No. - 50 #1036

RATIO CAL. = 2.29

CALIBRATION DATA

Run No.	Gamma Ray		FDC -- Before Log -- ACPS		FDC -- After Log -- ACPS	
	API Scale	Background CPS	Total CPS	P ₁	P ₂	P ₂
1	0-150	180	560	512	512	752
2						
3						
4						

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

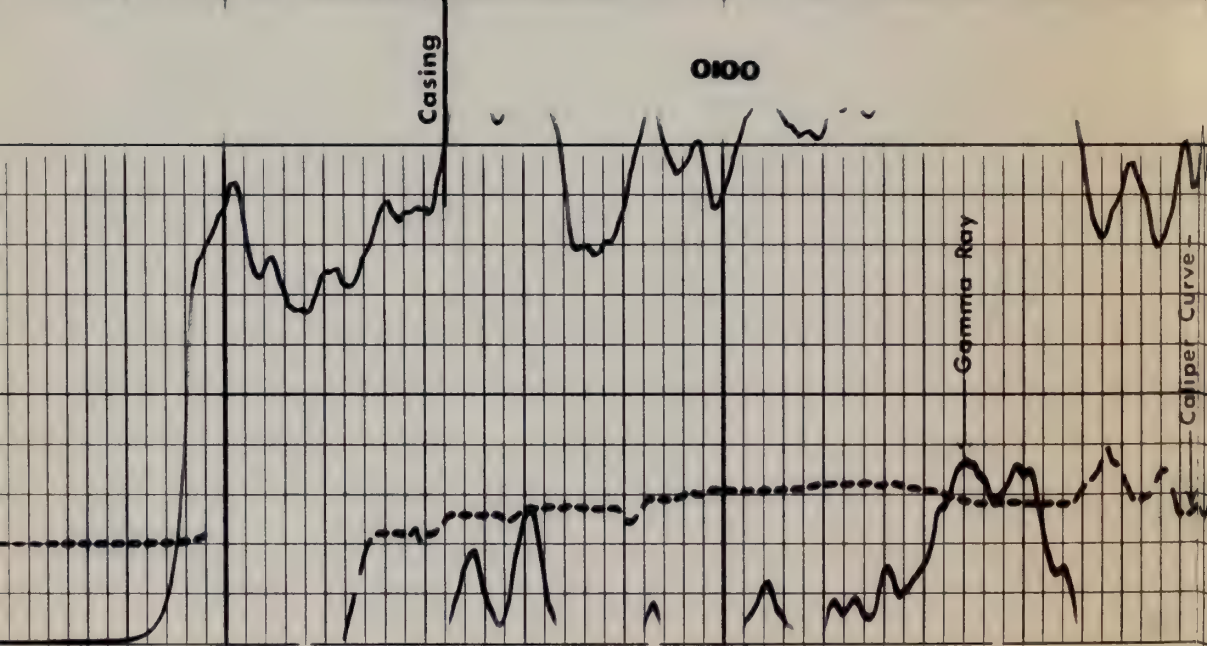
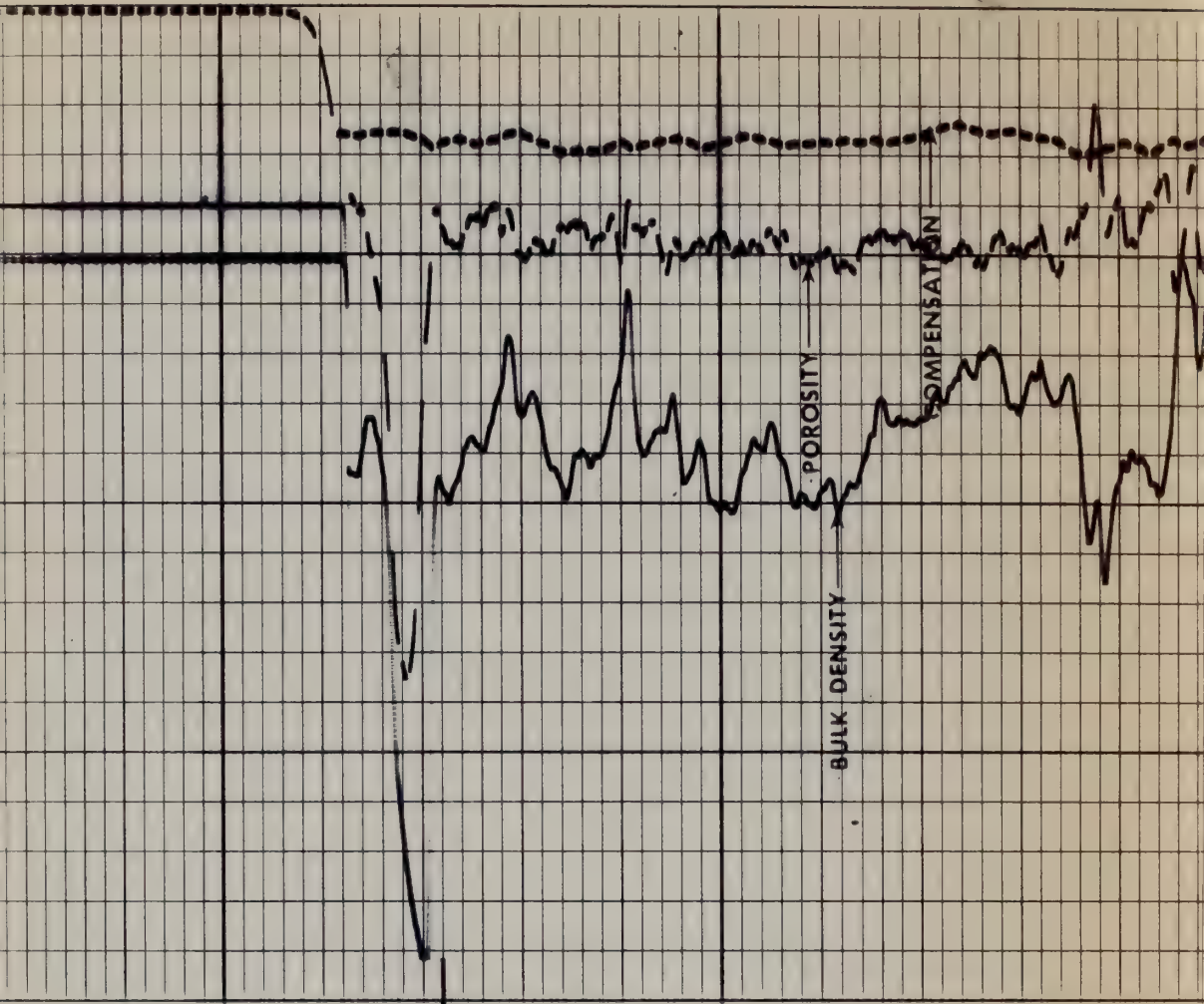
CALIPER		DEPTHS	
HOLE DIAM. IN INCHES			
6	16		
GAMMA RAY			
API UNITS			
0	150		
150	300		

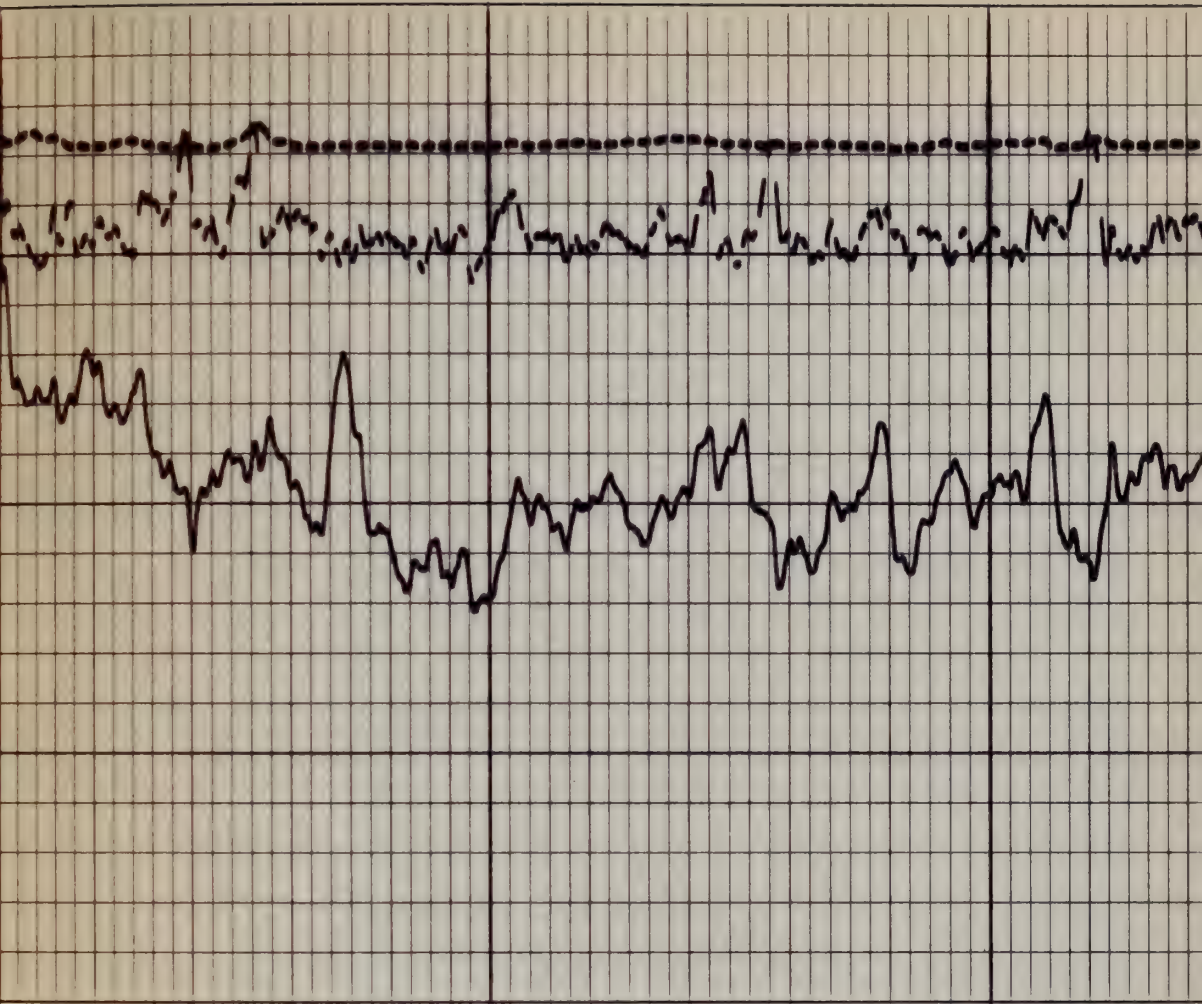
RATIO
 5.0 2.5 0
 .25 0 .25

CORRECTION
 GRAMS/CC.

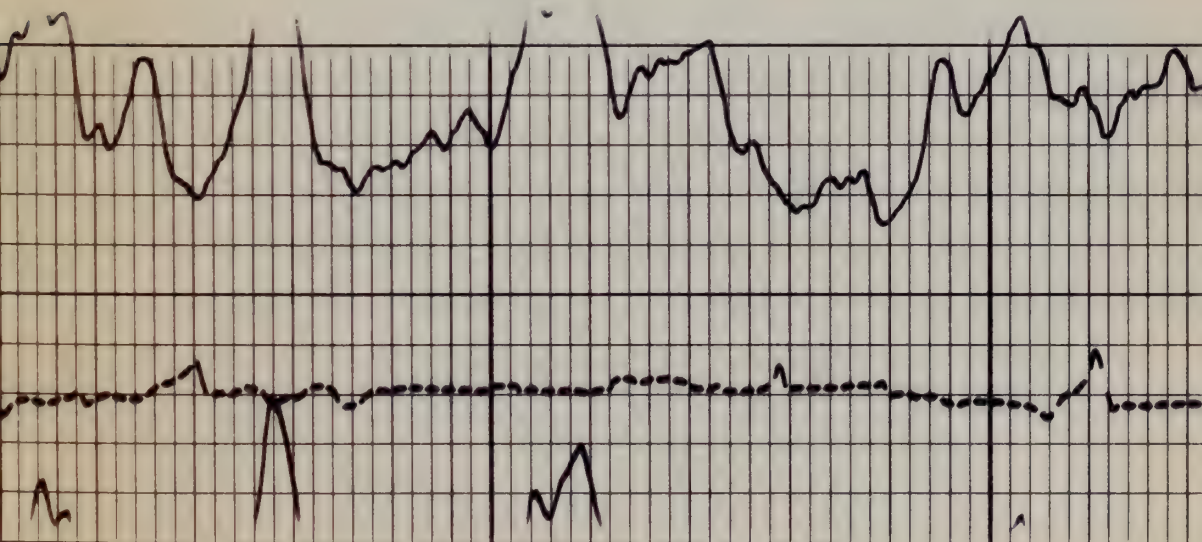
BULK DENSITY
 GRAMS CC.

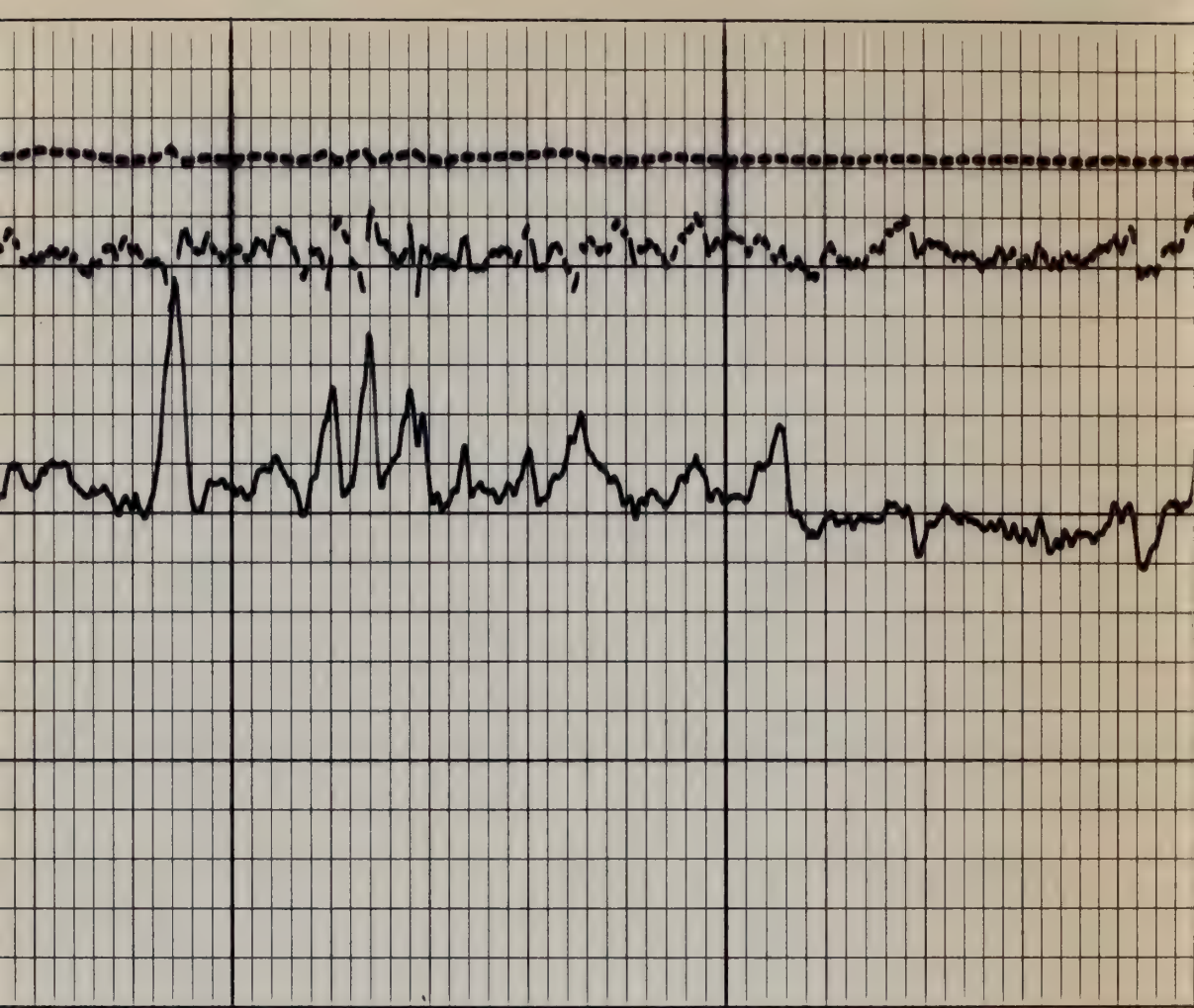
1.70 2.20 2.70
 .70 1.20 1.70



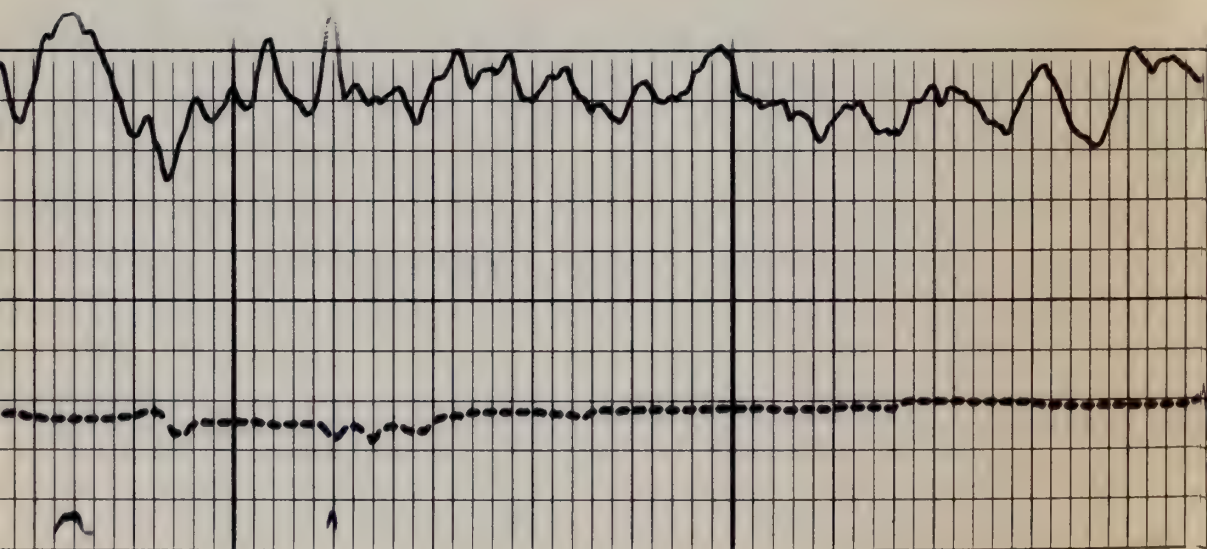


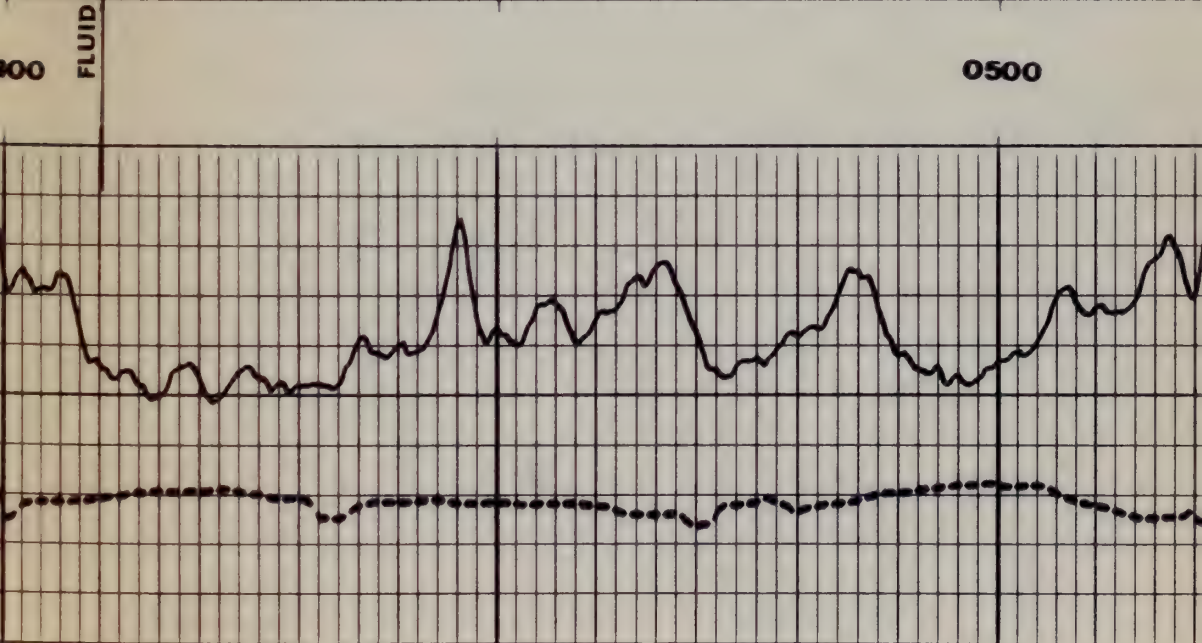
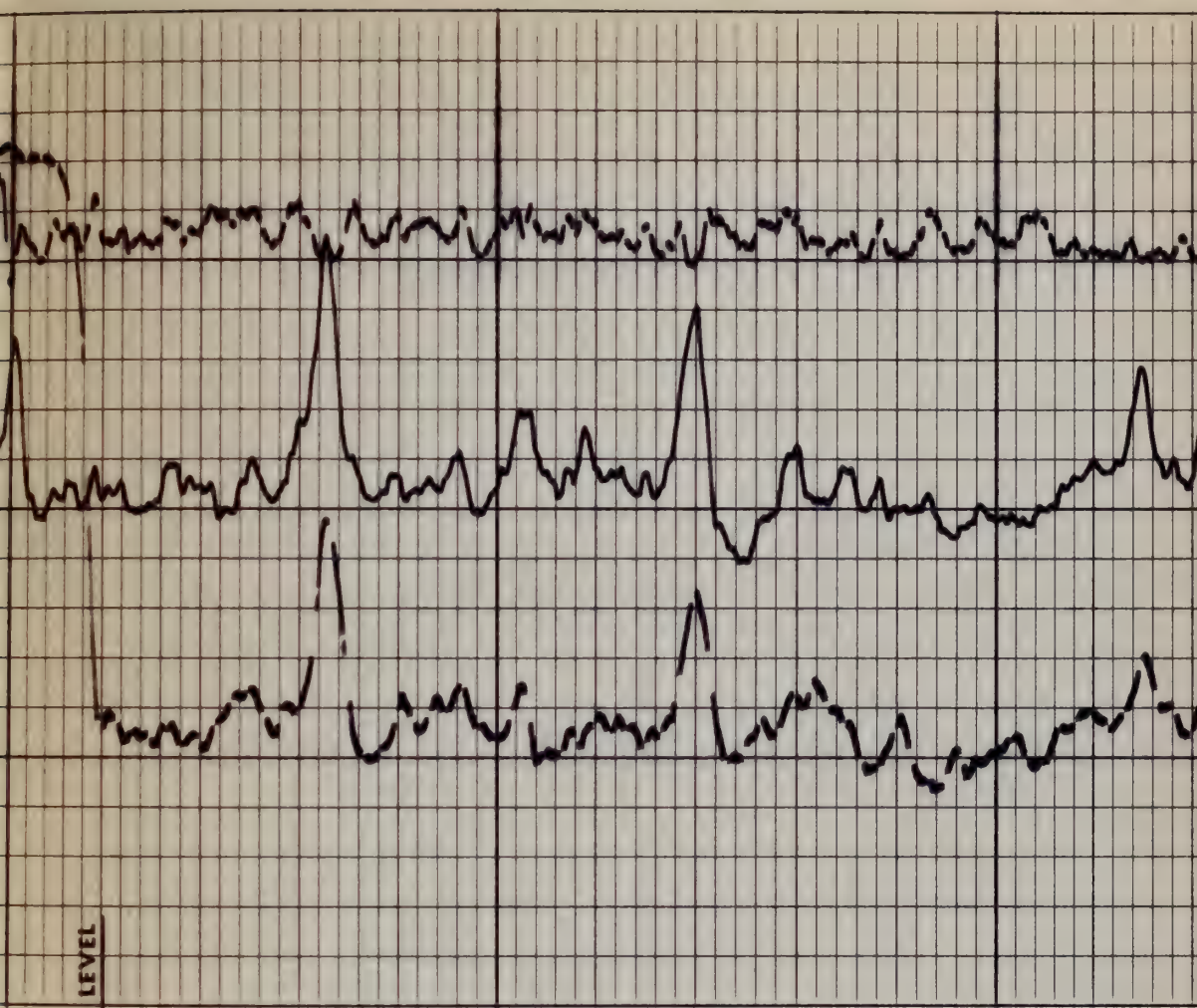
0200





0300

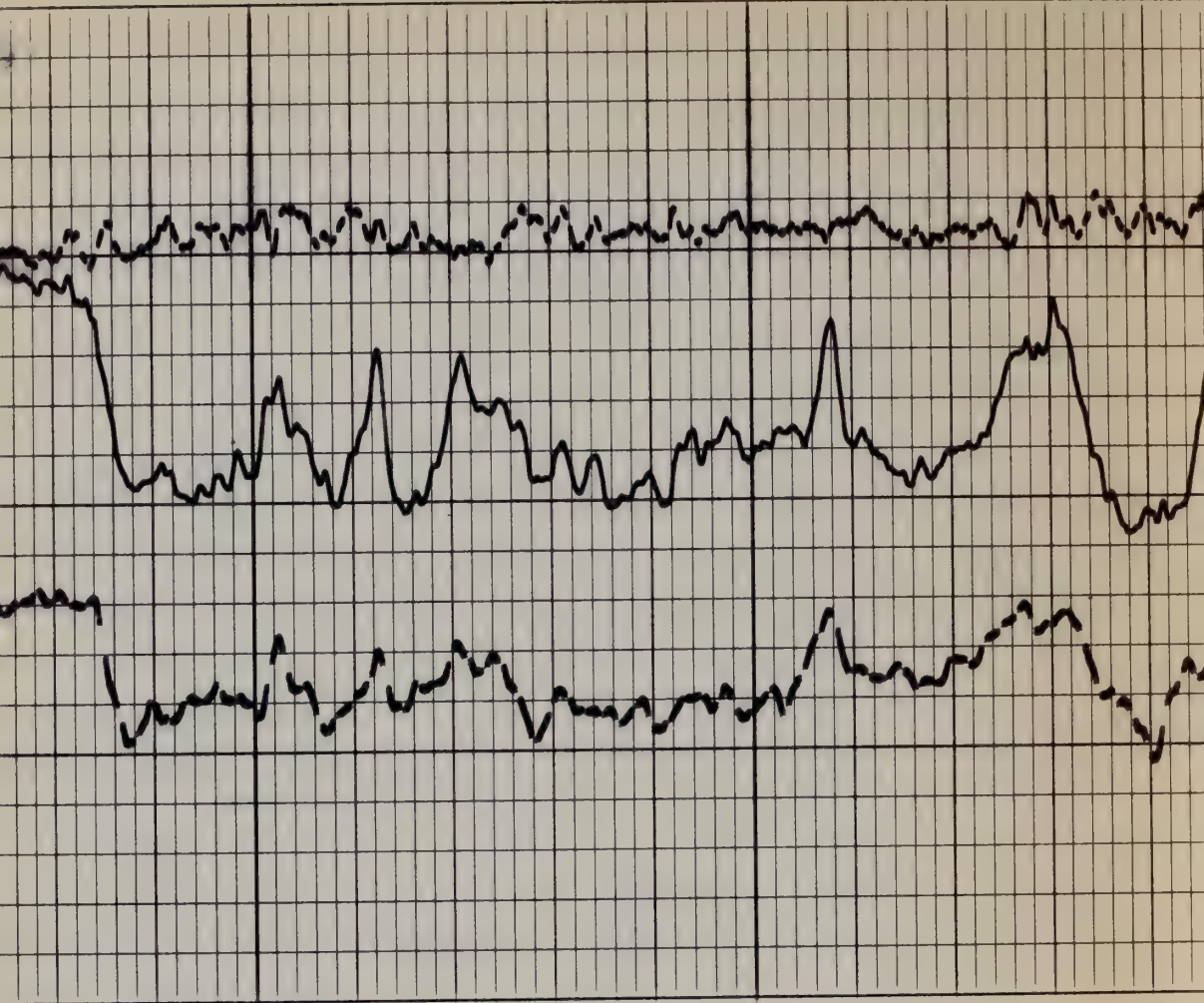




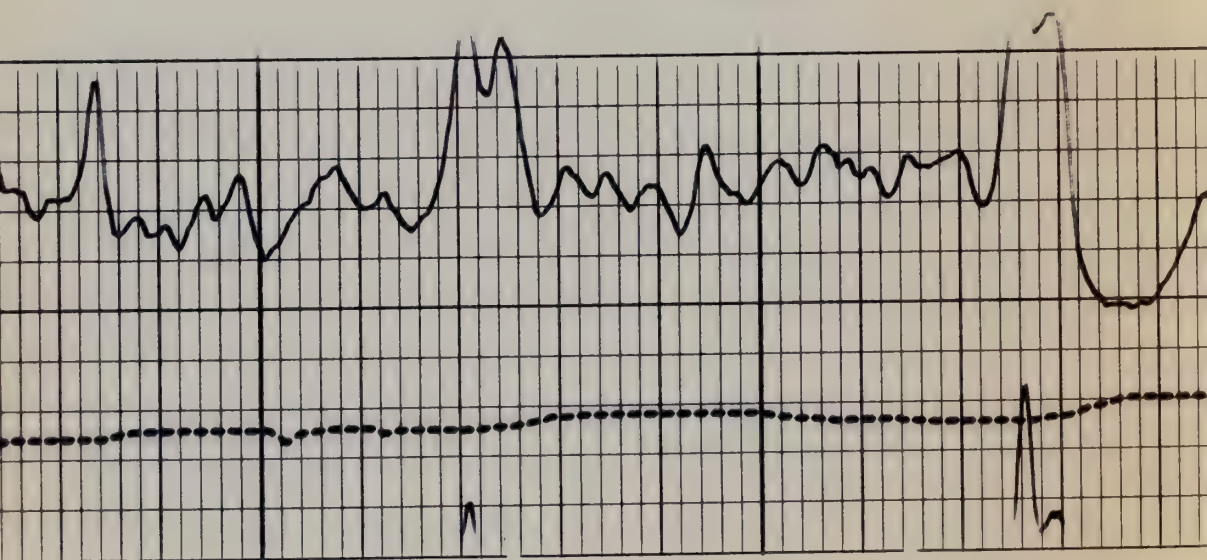
FLUID LEVEL

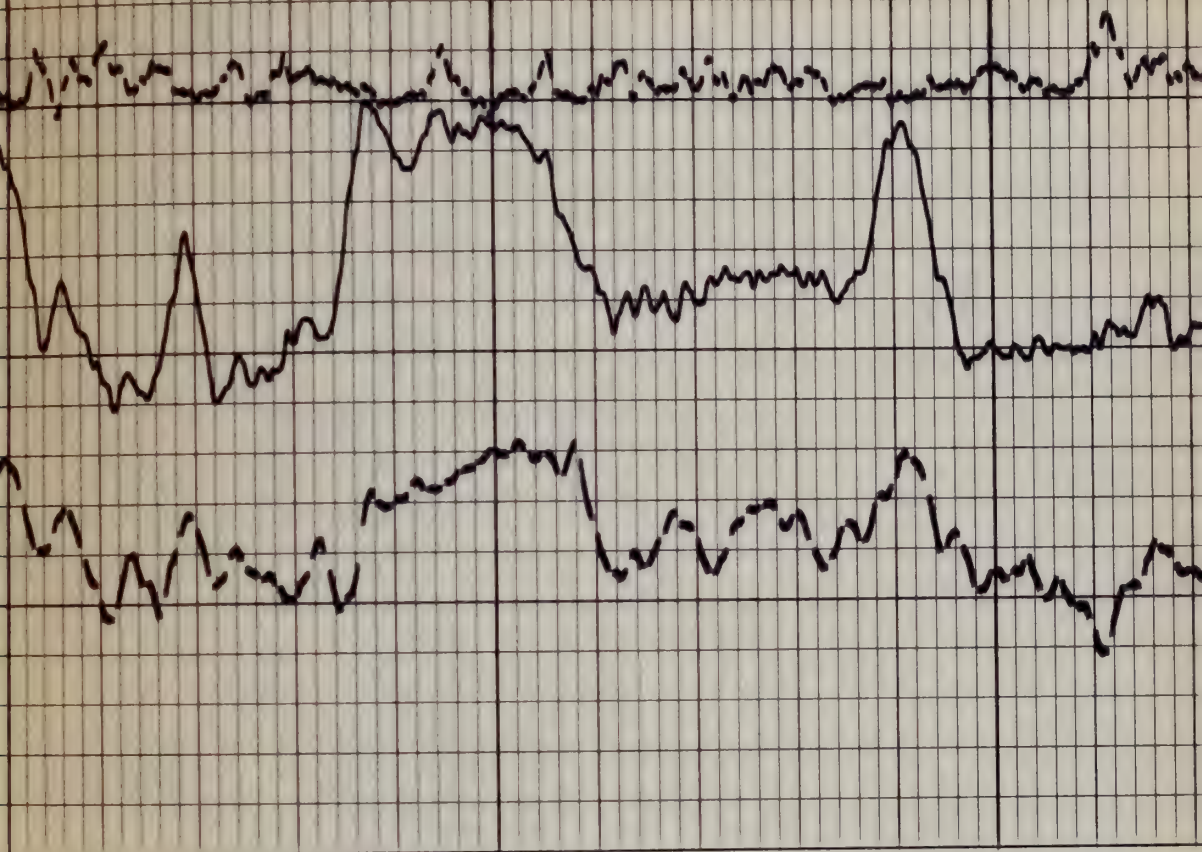
000

0500

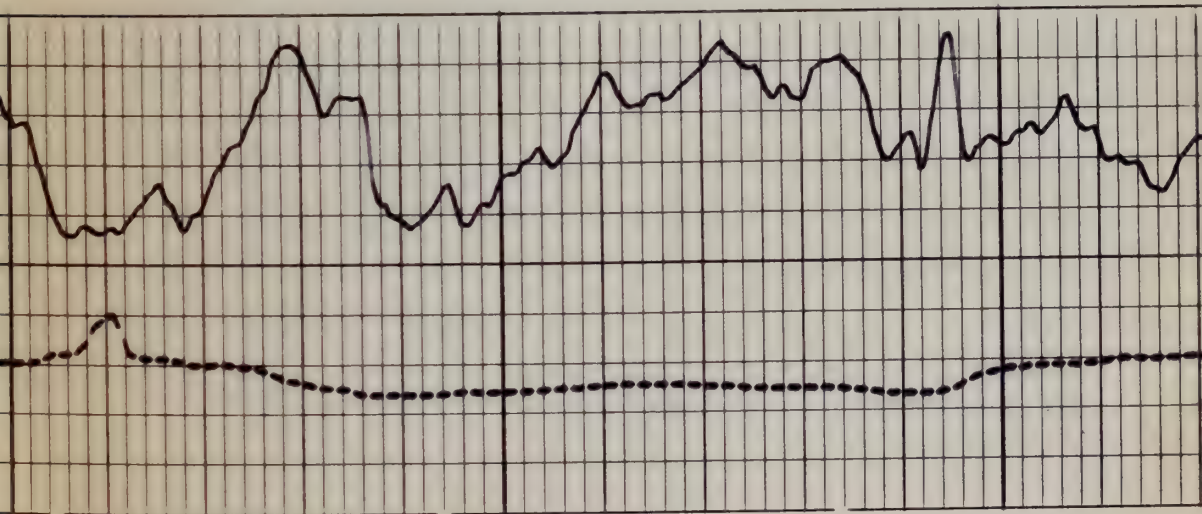


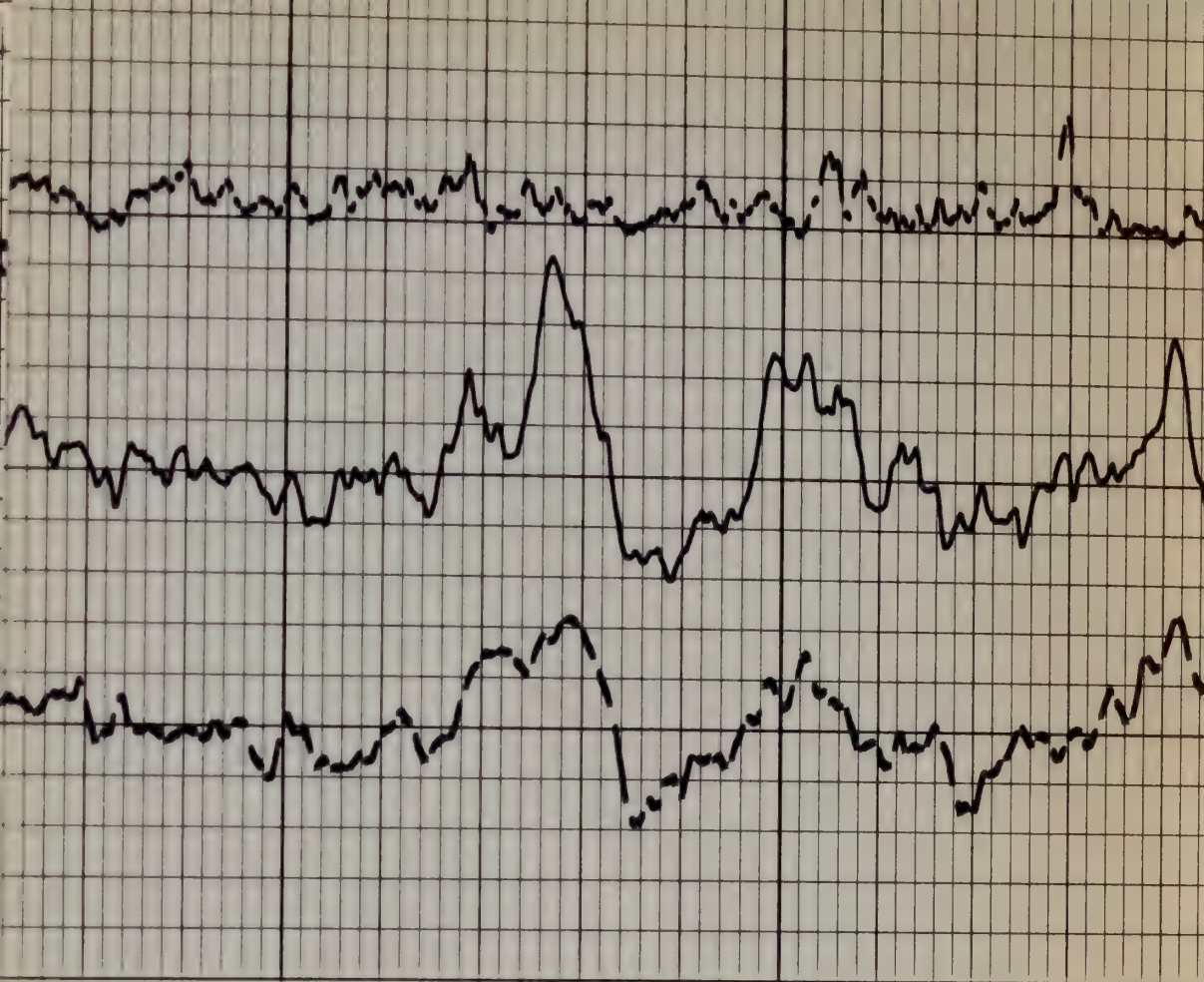
0600



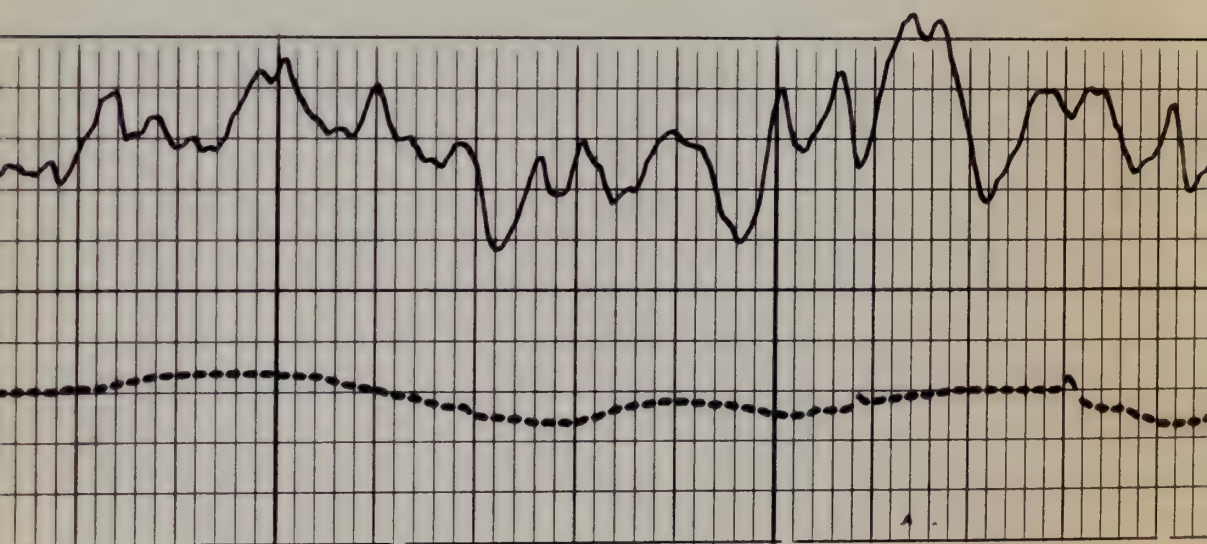


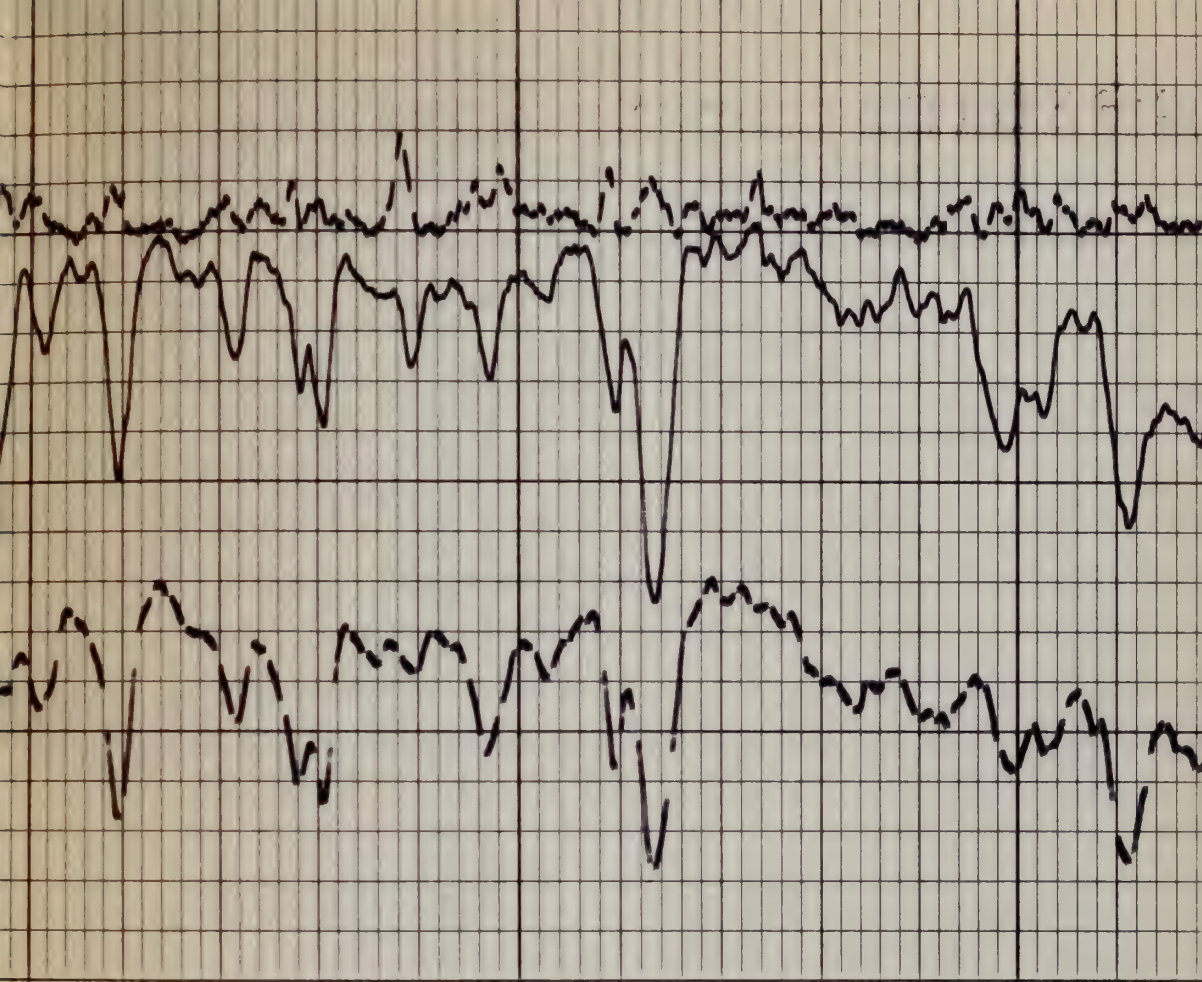
0700





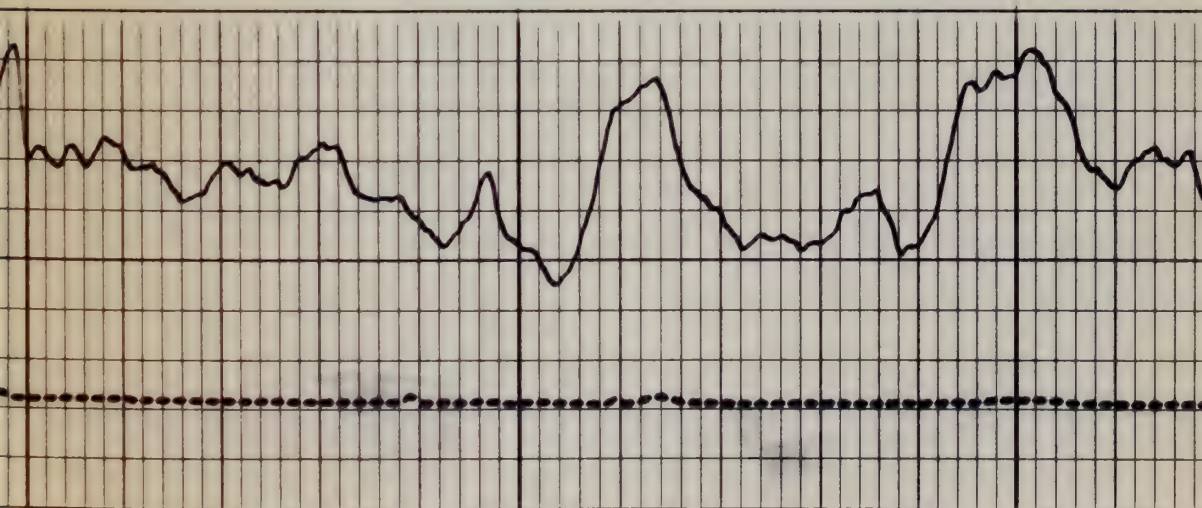
0800

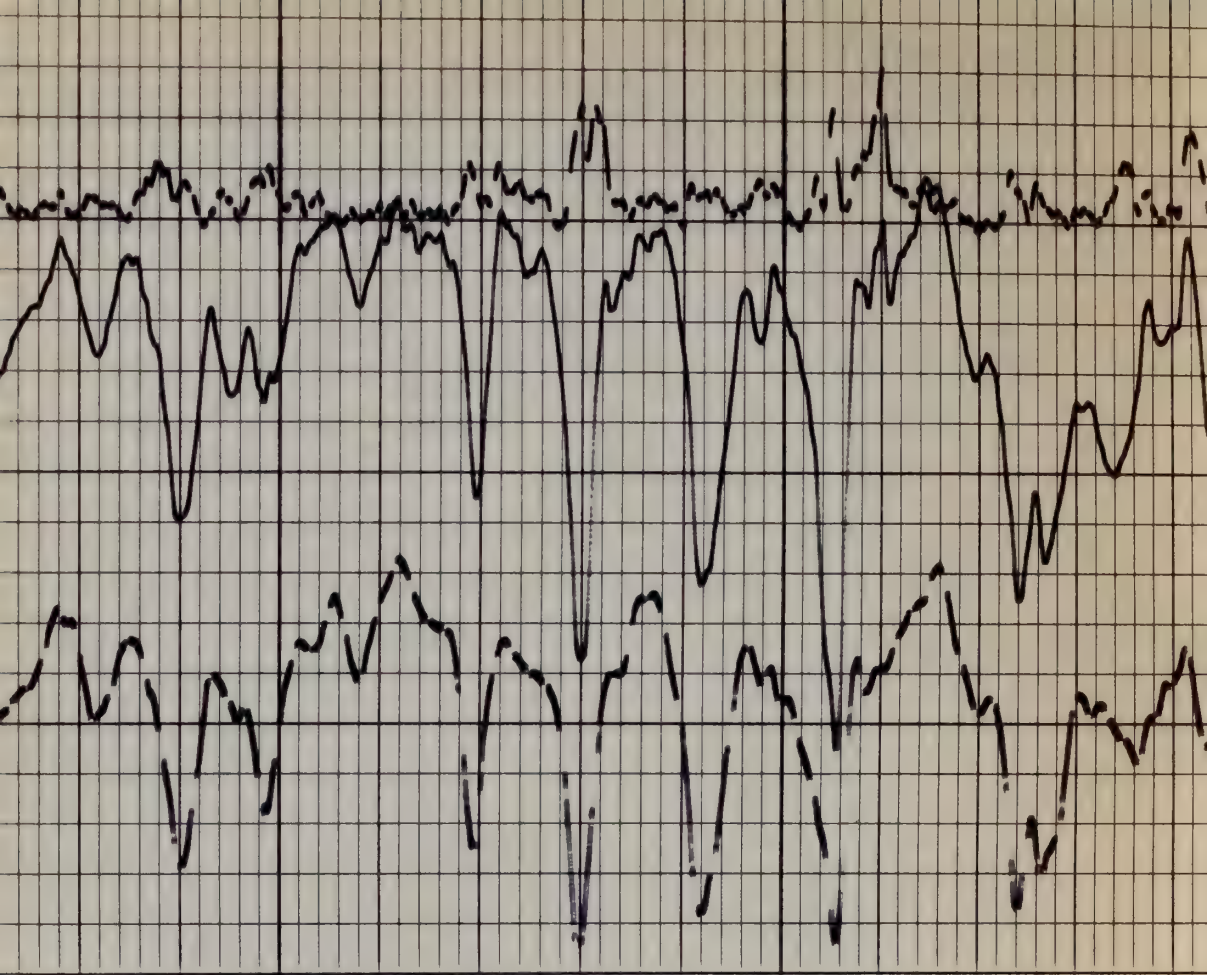




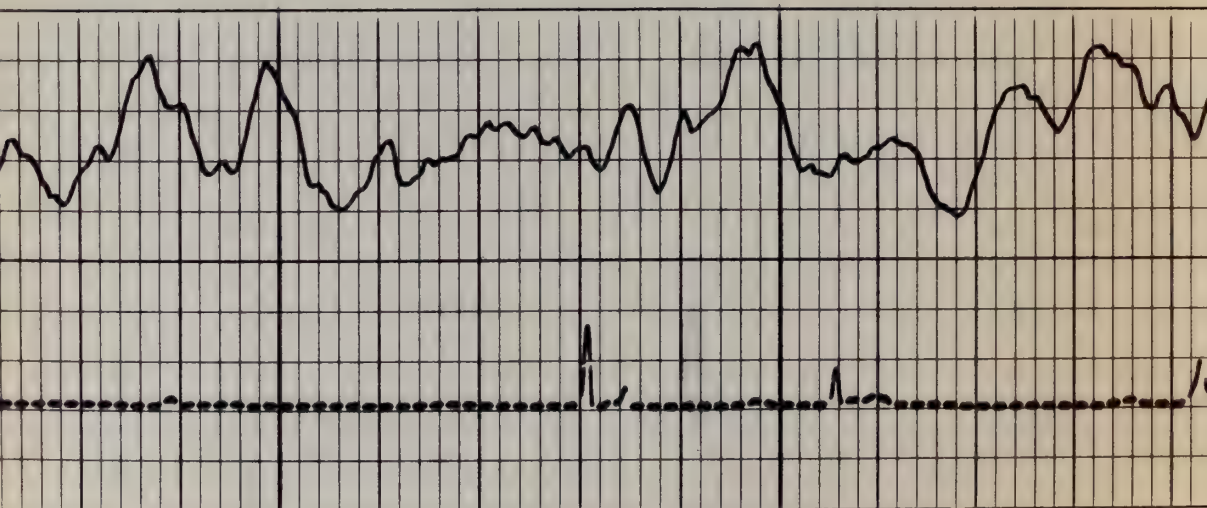
0900

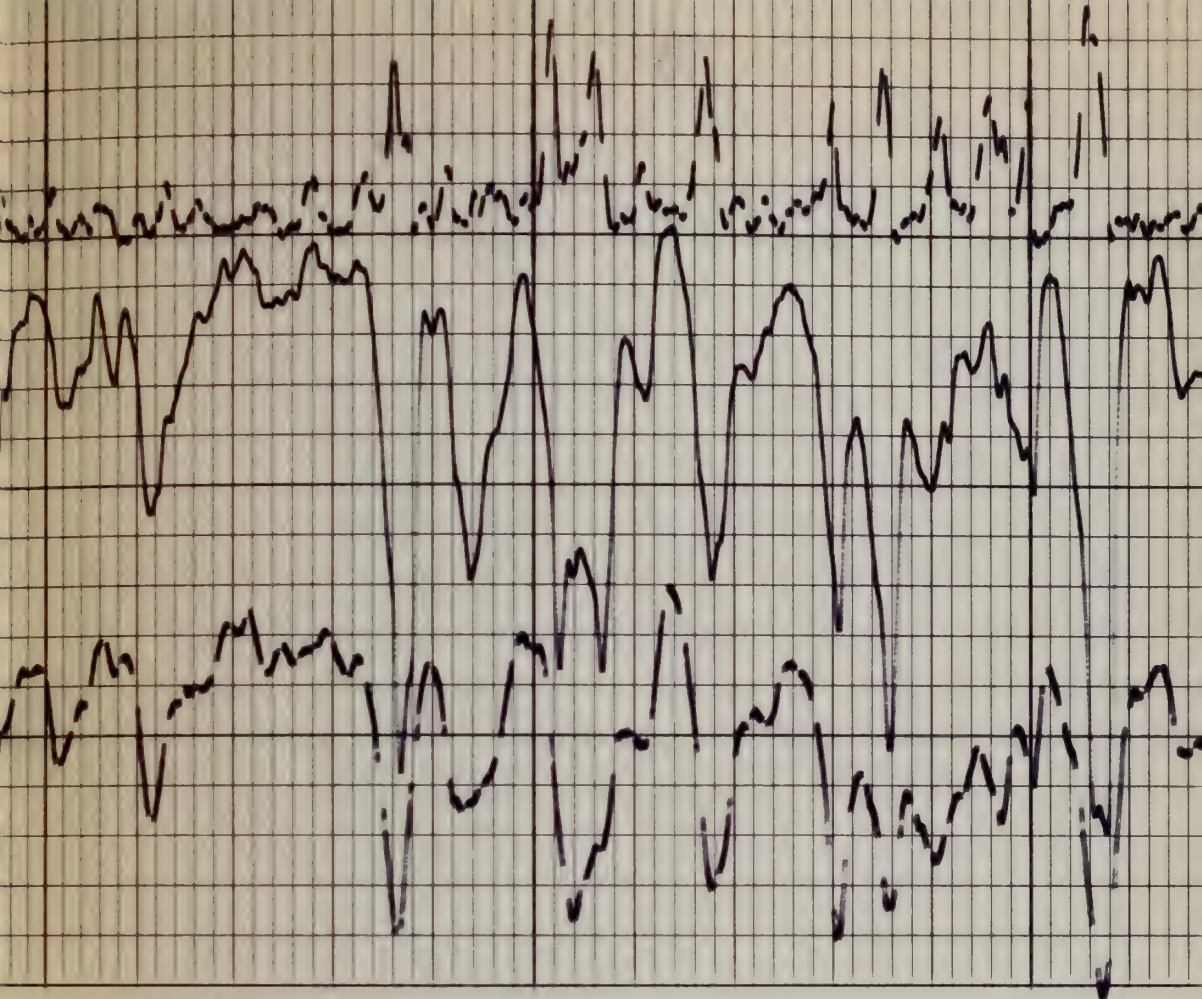
1000



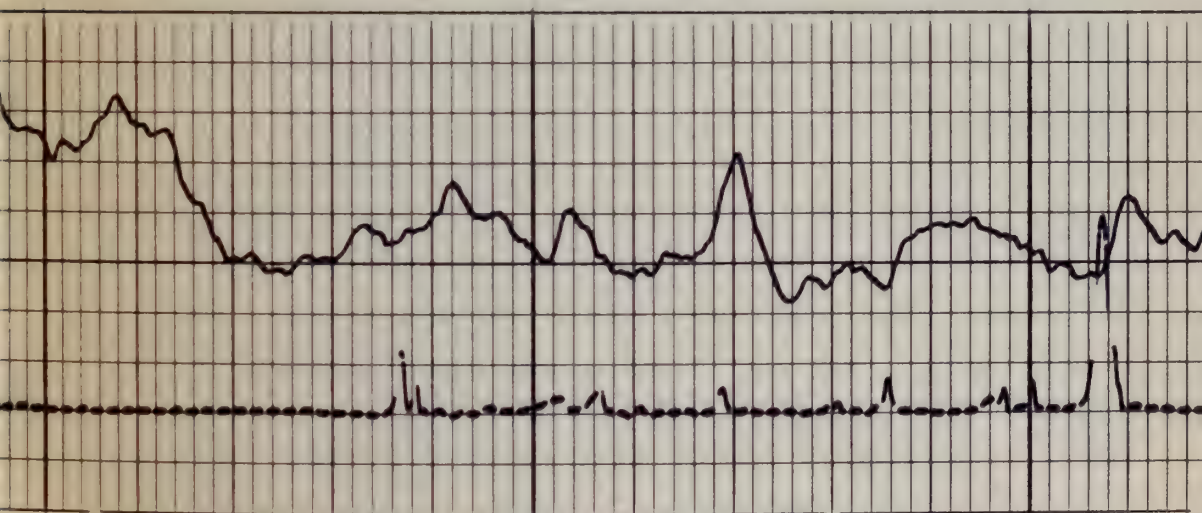


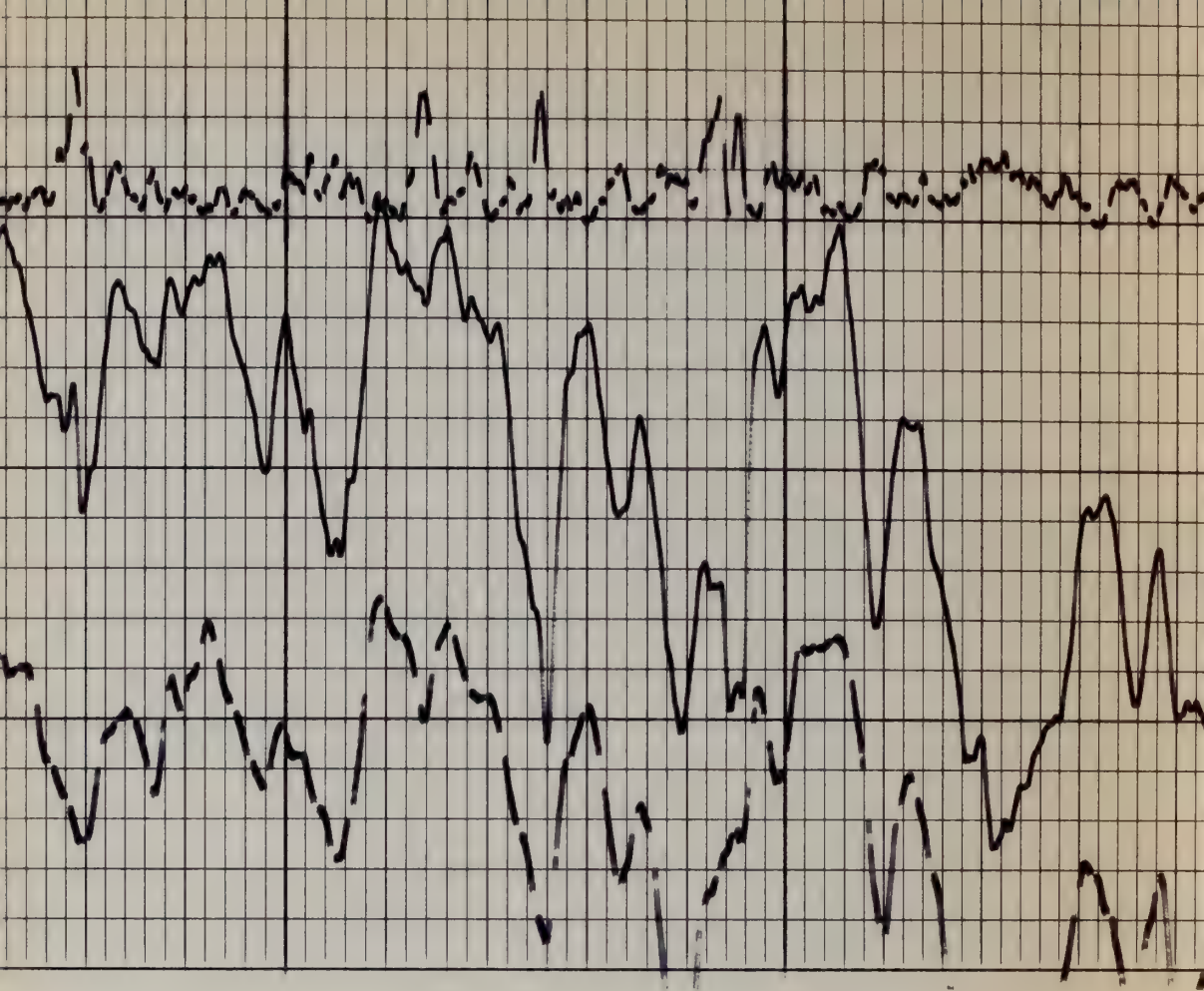
1100



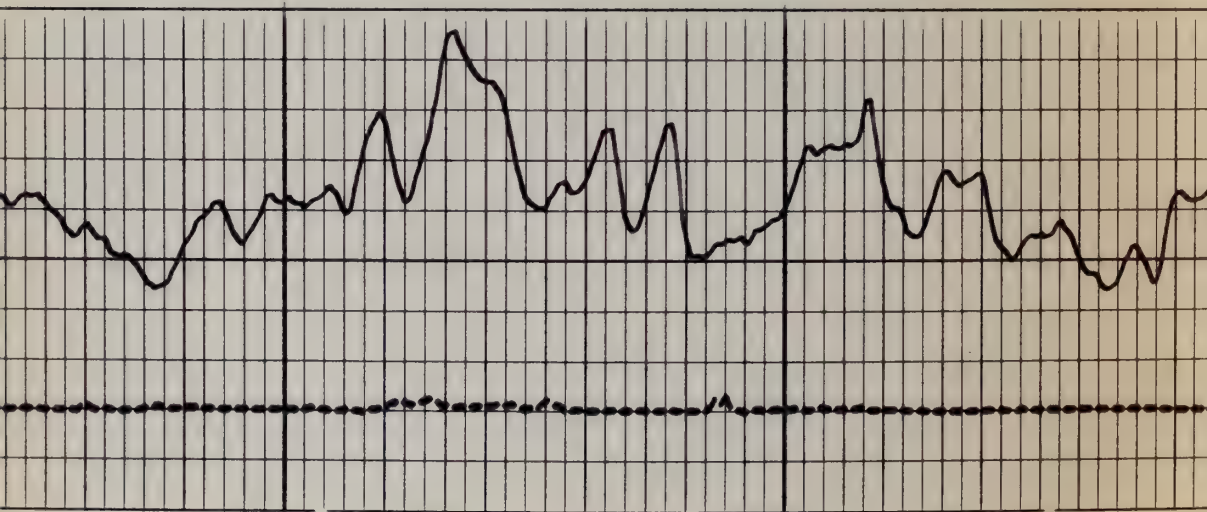


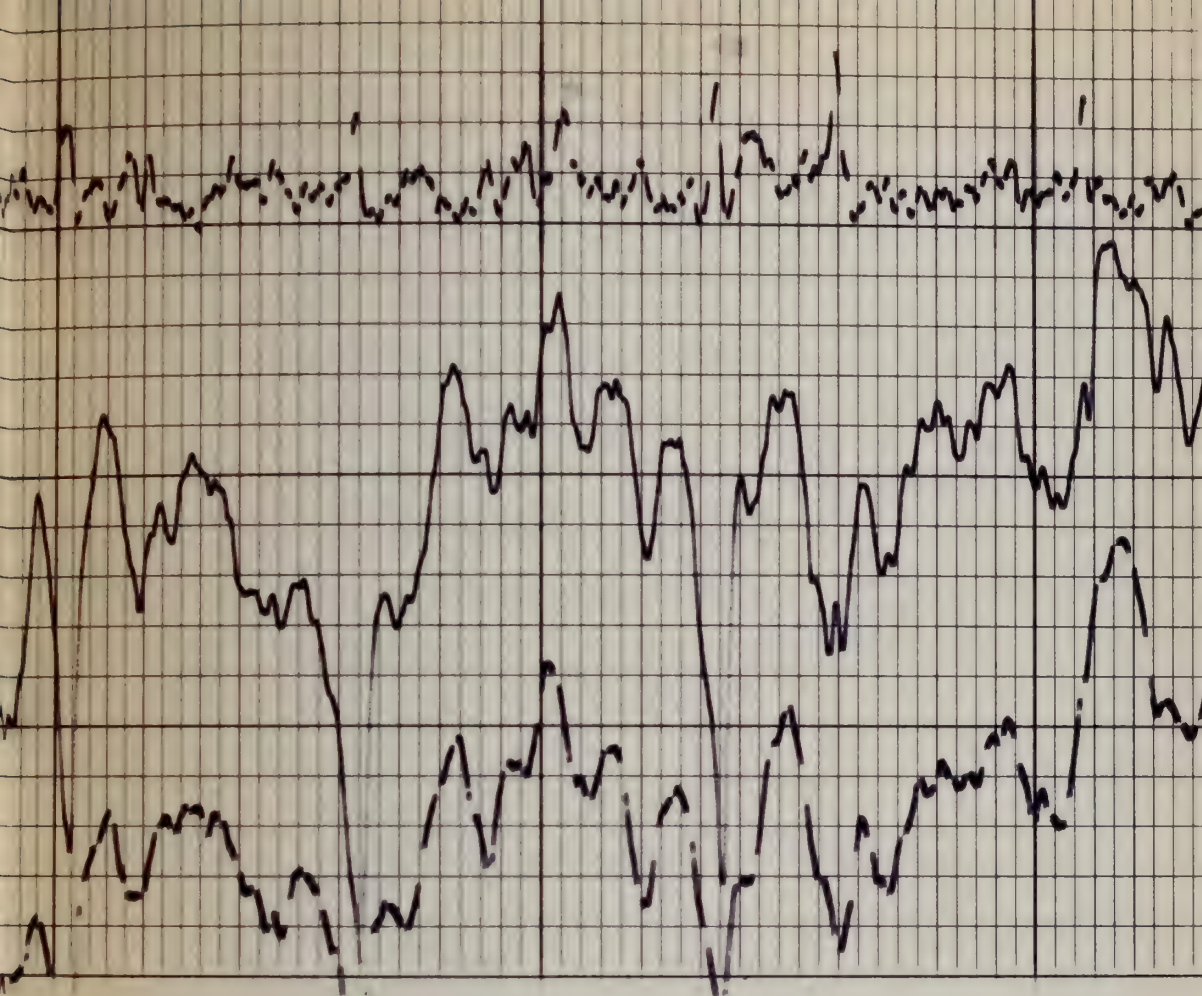
1200





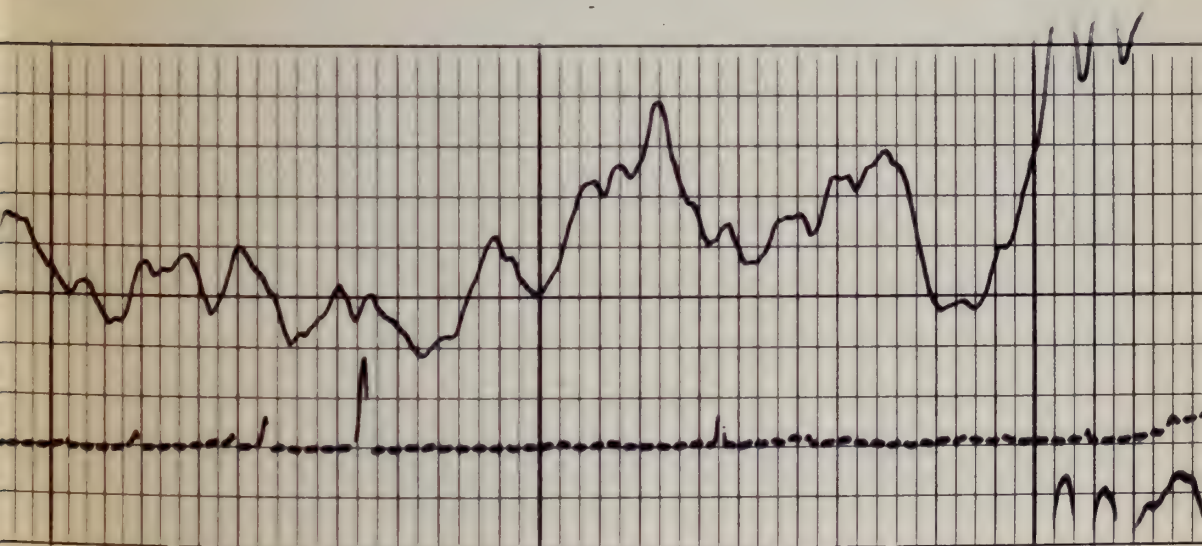
1300

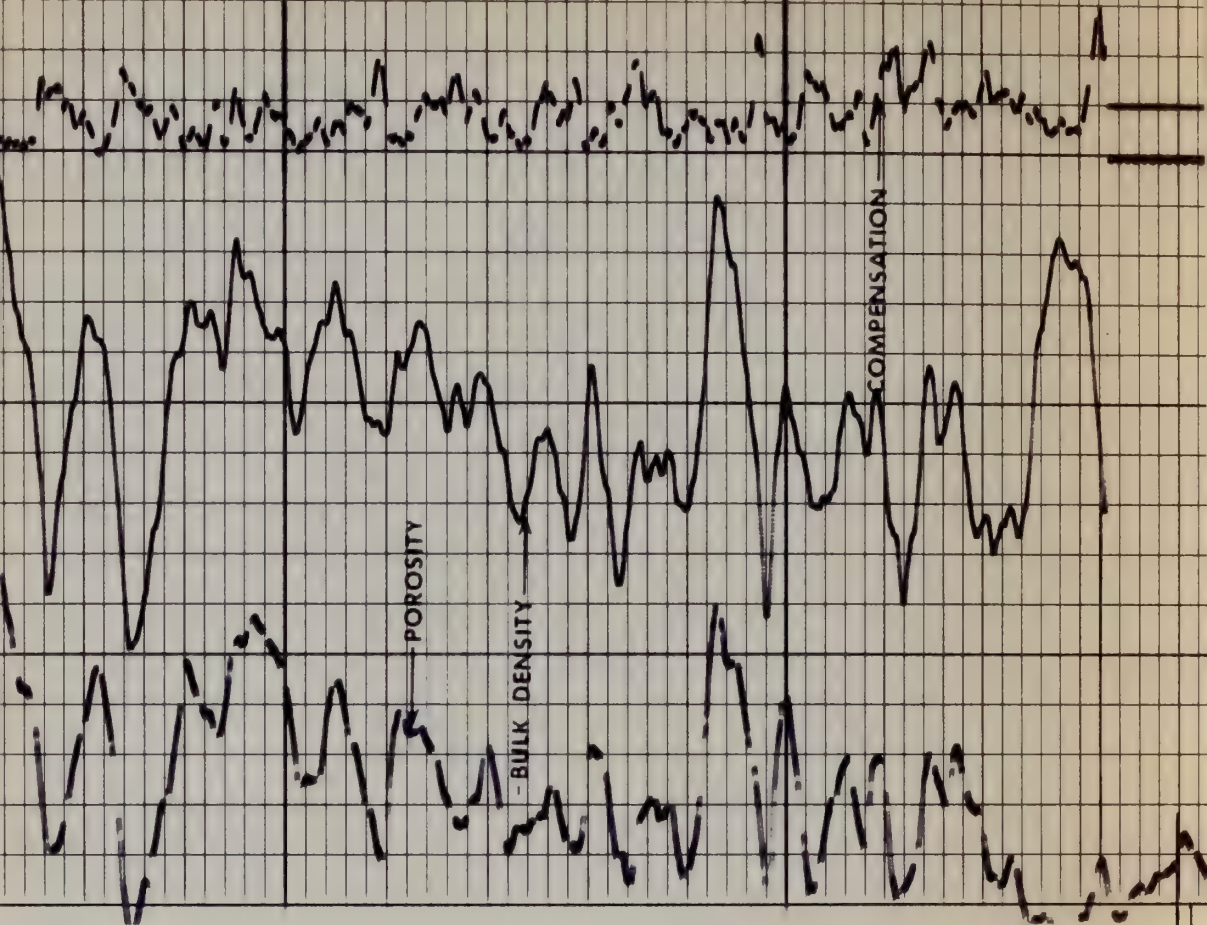




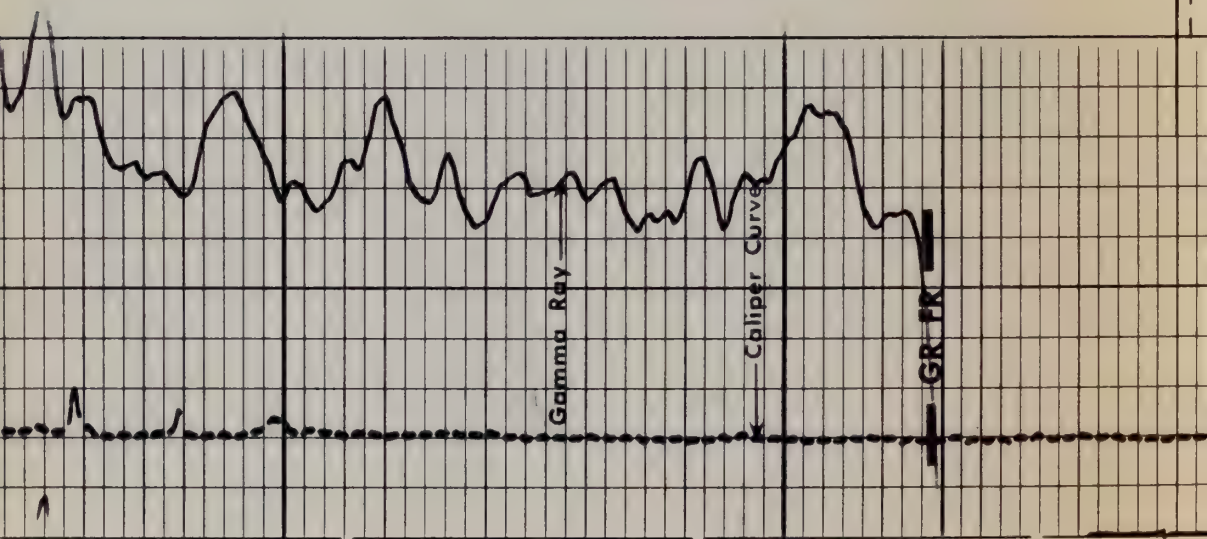
1400

1500

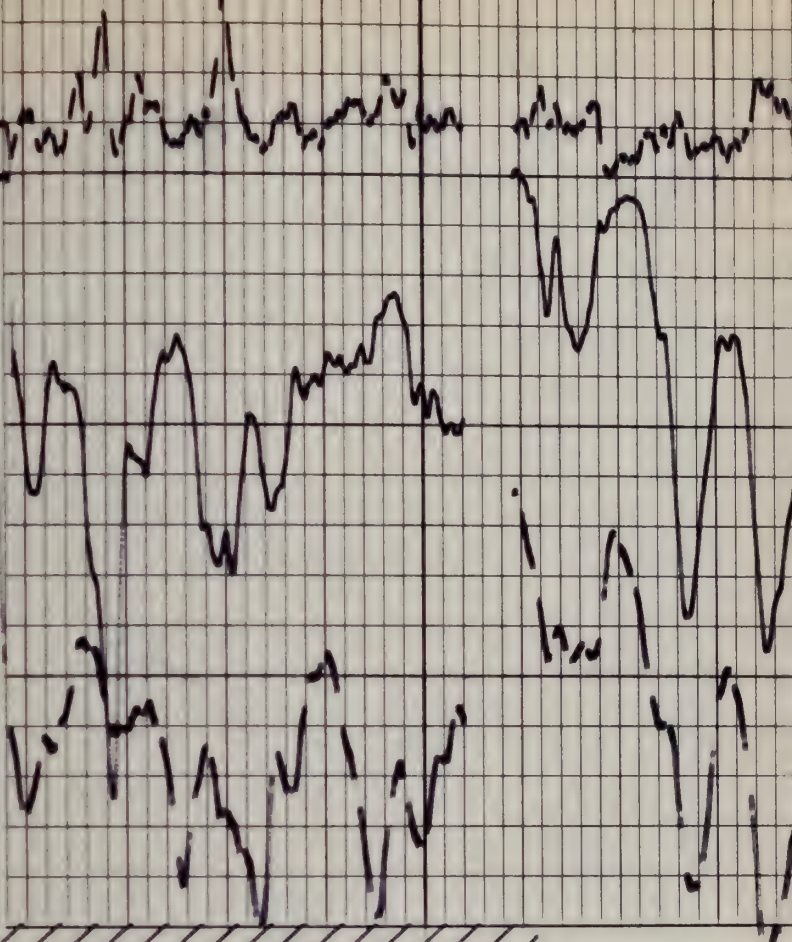




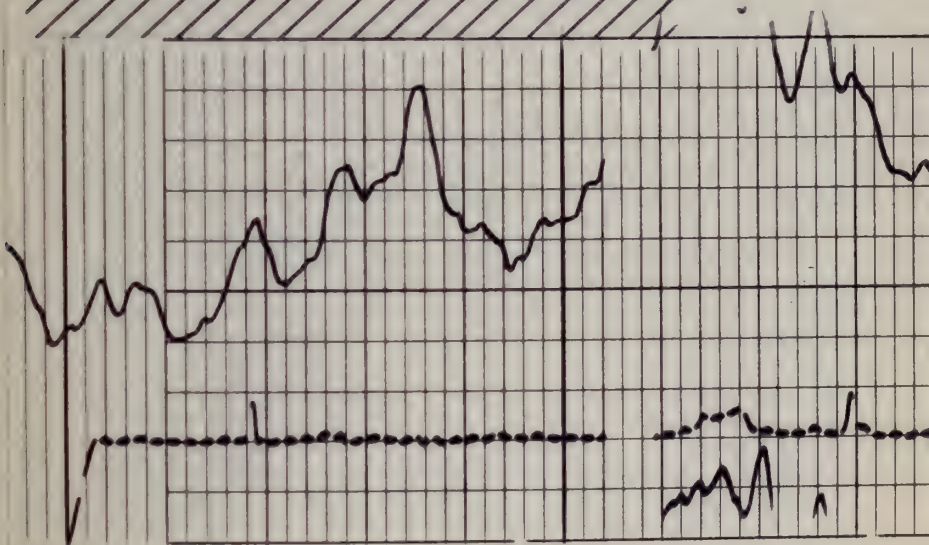
1600

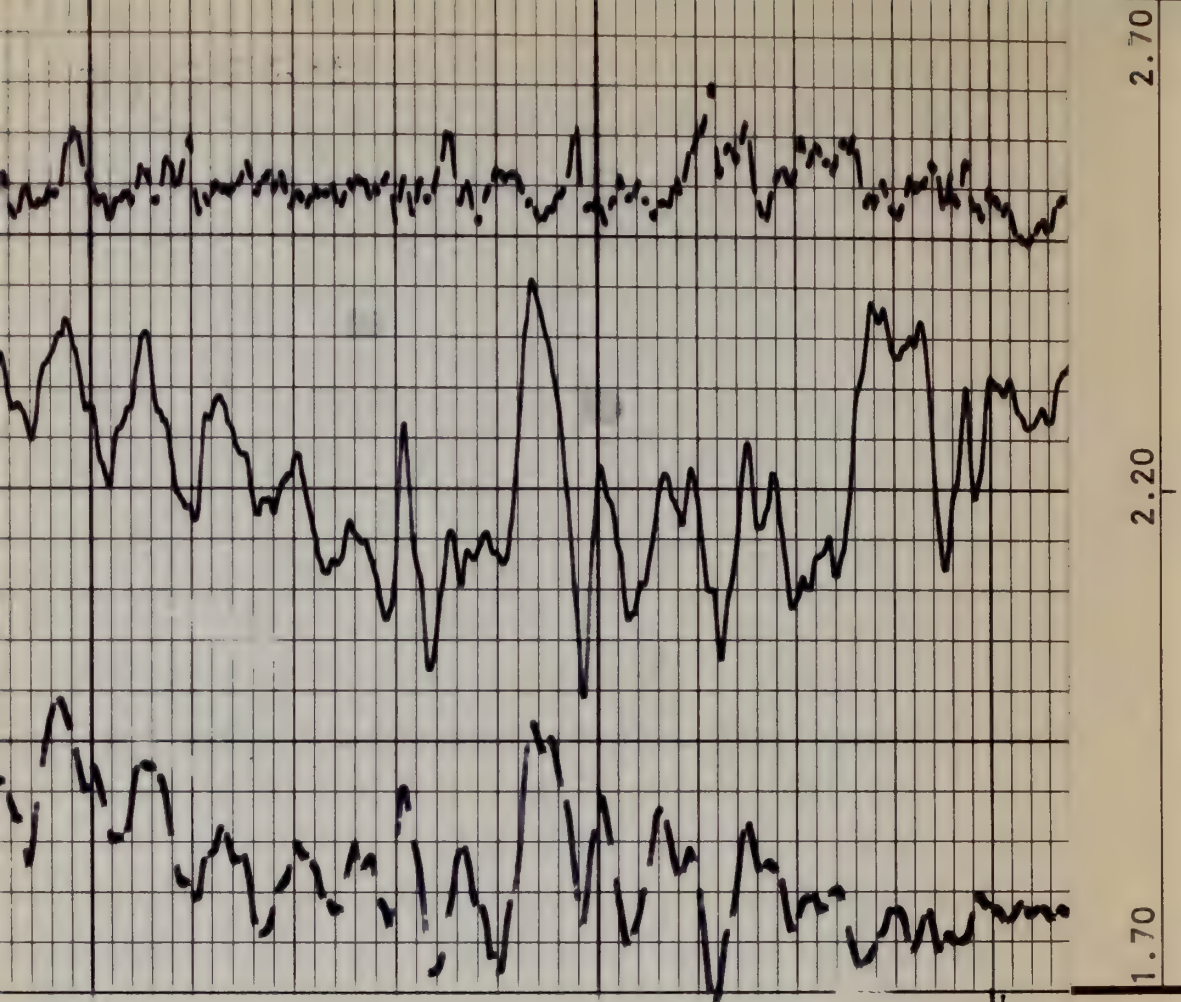


REPEAT SECTION

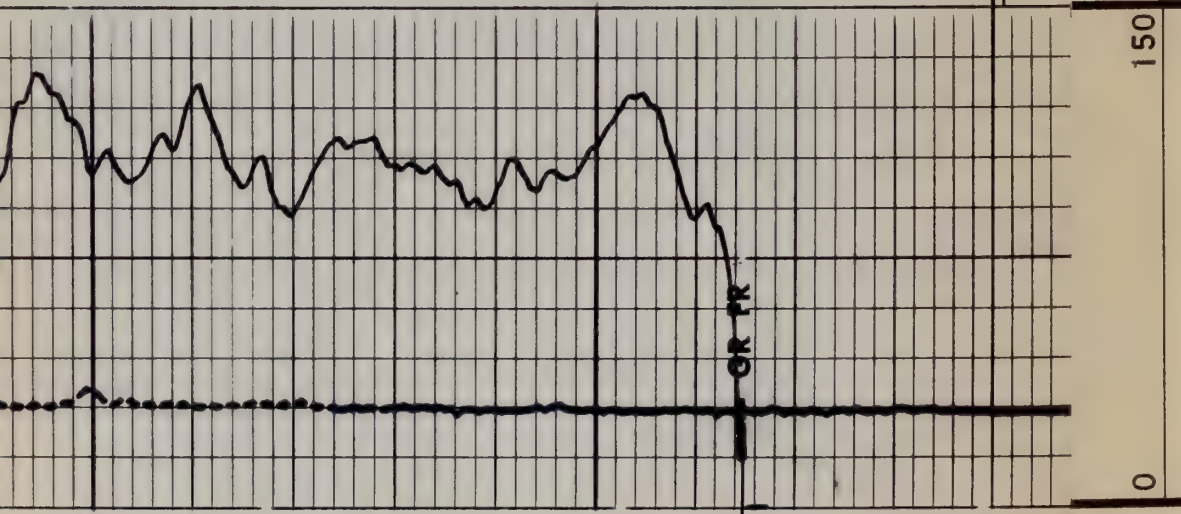


MEMORIZER OUT — CURVES 1500 ALID





1600



150 300

.70

1.20

1.70

GAMMA RAY

API UNITS

BULK DENSITY

GRAMS/CC.

6 16

-.25 0 +.25

CORRECTION

GRAMS/CC.

CALIPER

HOLE DIAM. IN INCHES

RATIO

2.5

DEPTHS

5.0

0

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640

SCHL. TD 1641

DRLR TD 1638

Elev:

KB -----

DF -----

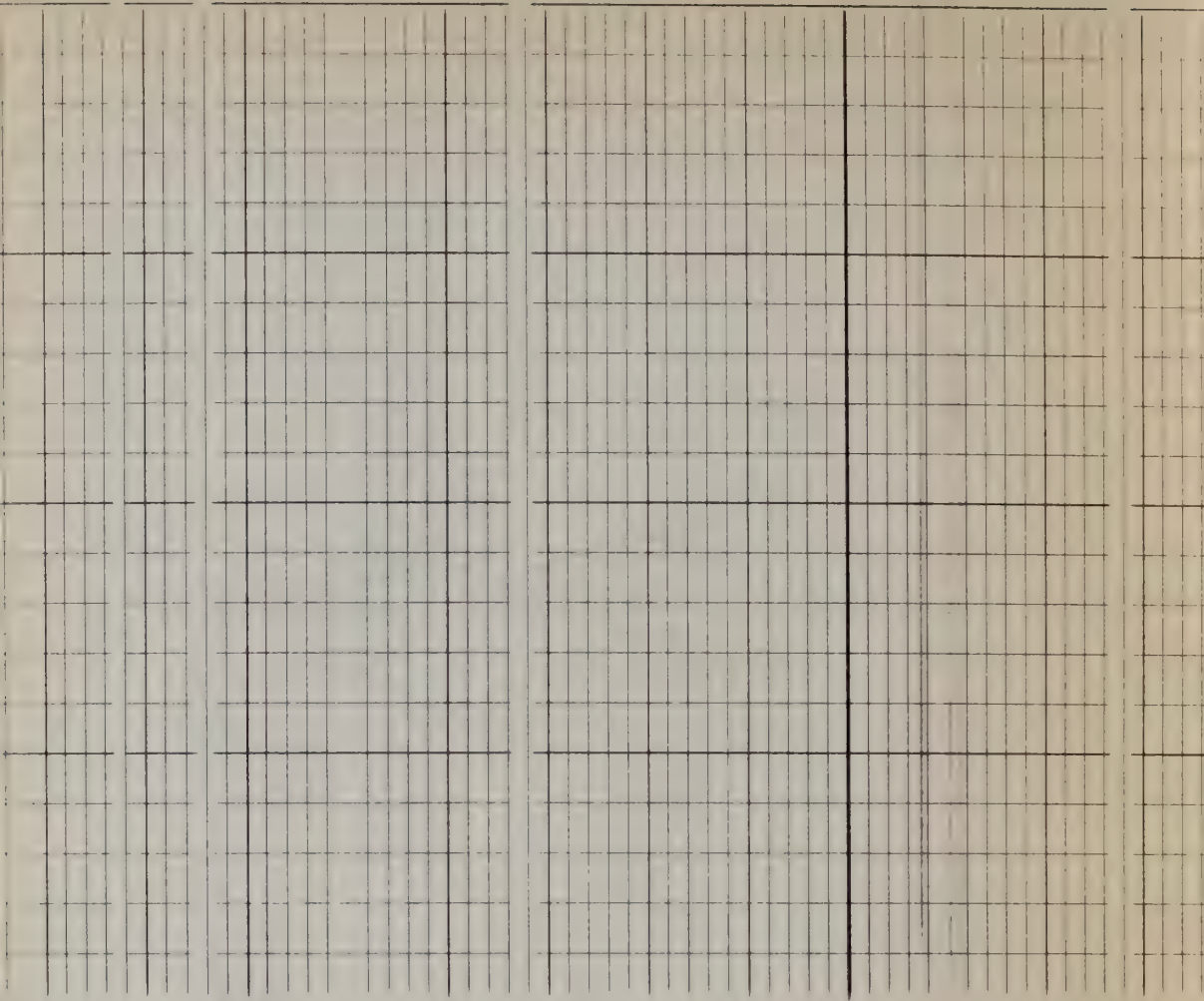
GL 6909

CALIBRATION RECORD



G. R. SURFACE CALIBRATION

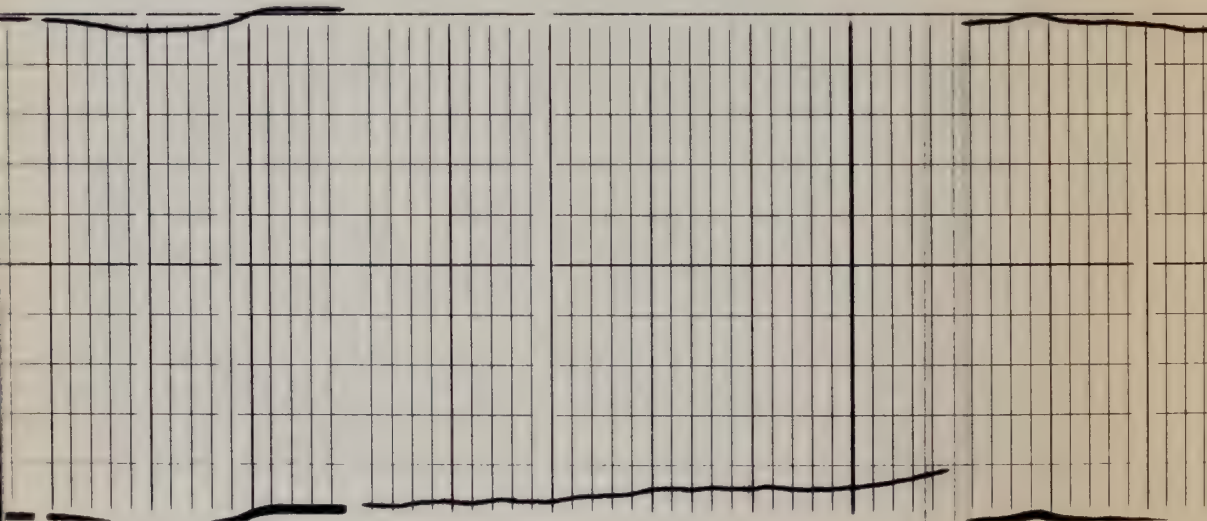
1 2



4

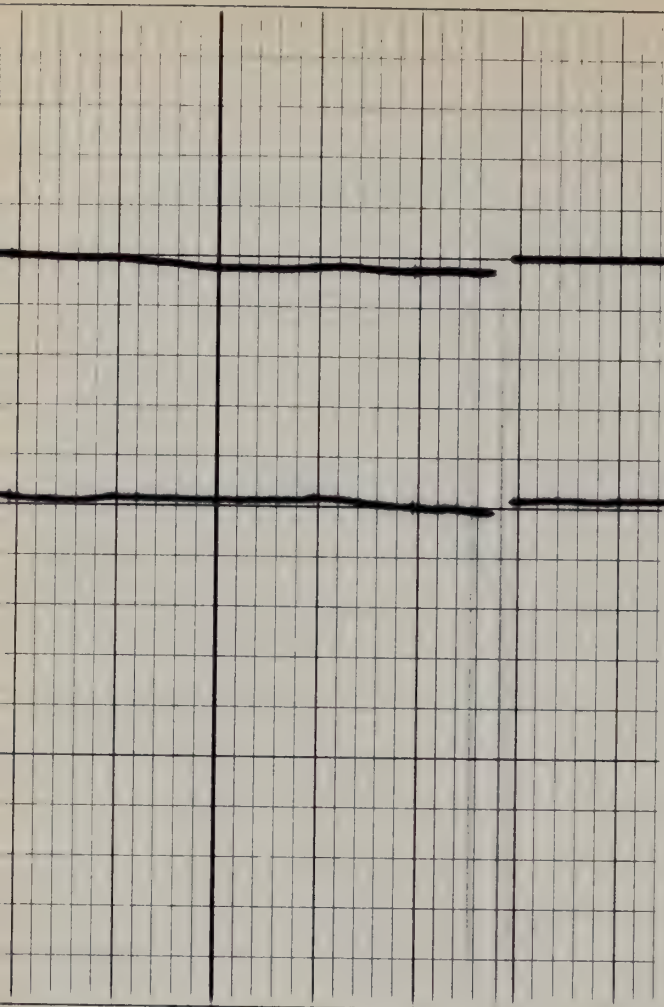
5

6

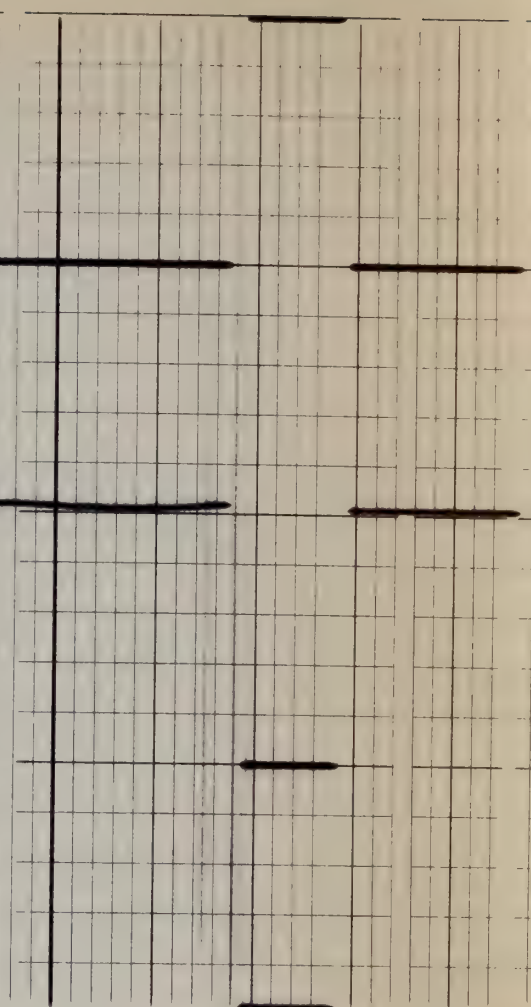


Calibration after Survey

12



10



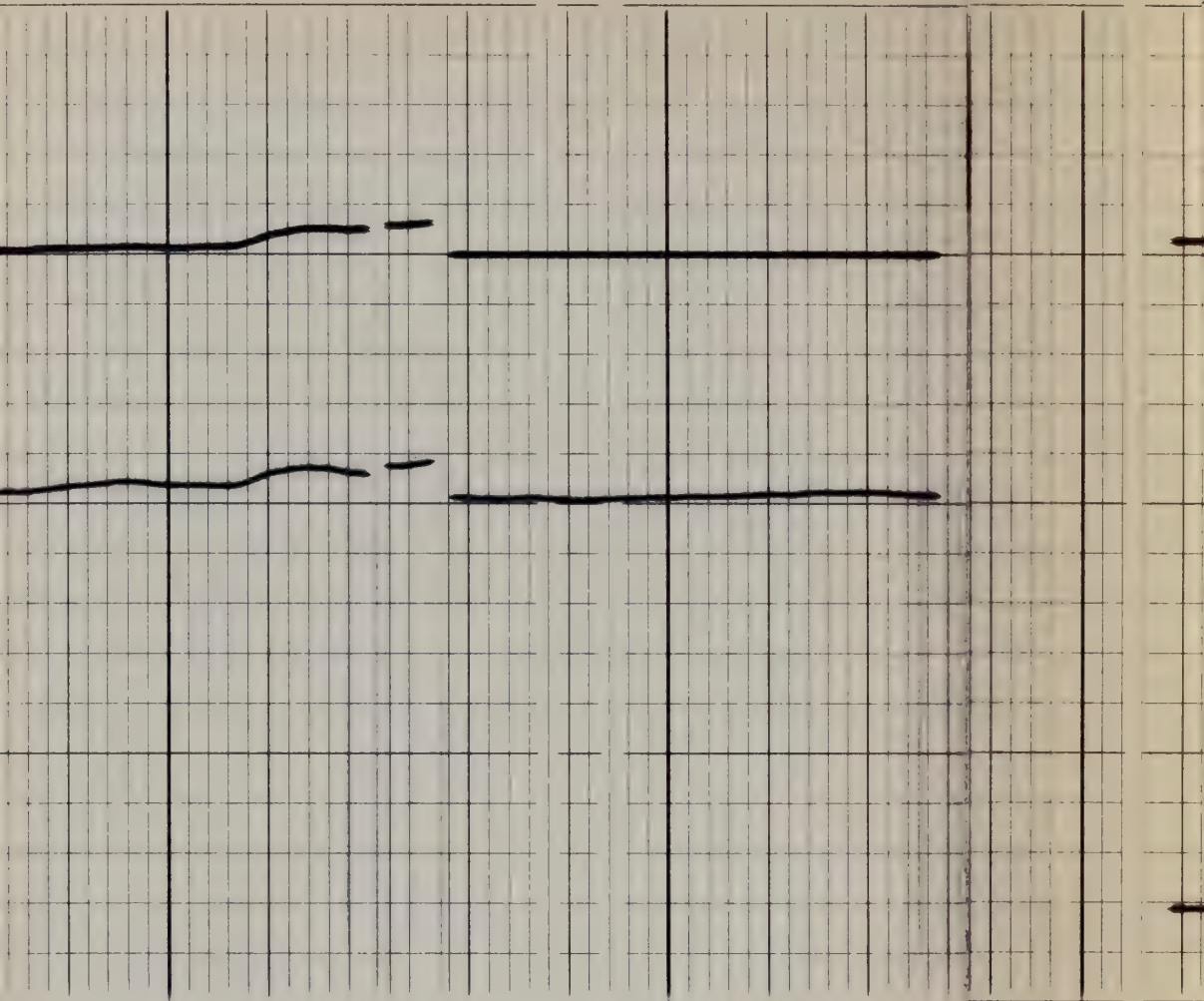
2

1

Calibration before Survey

12

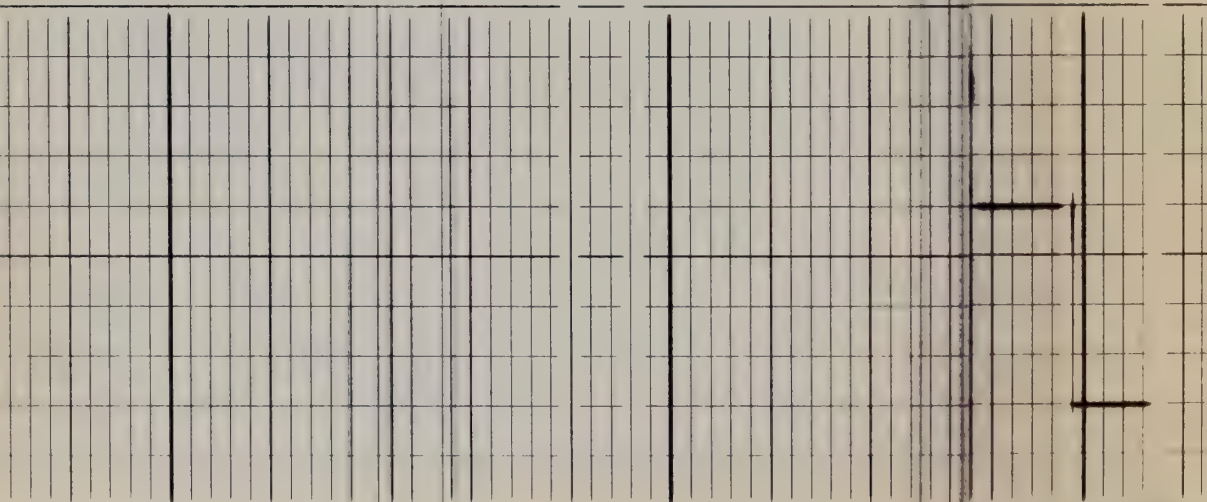
11



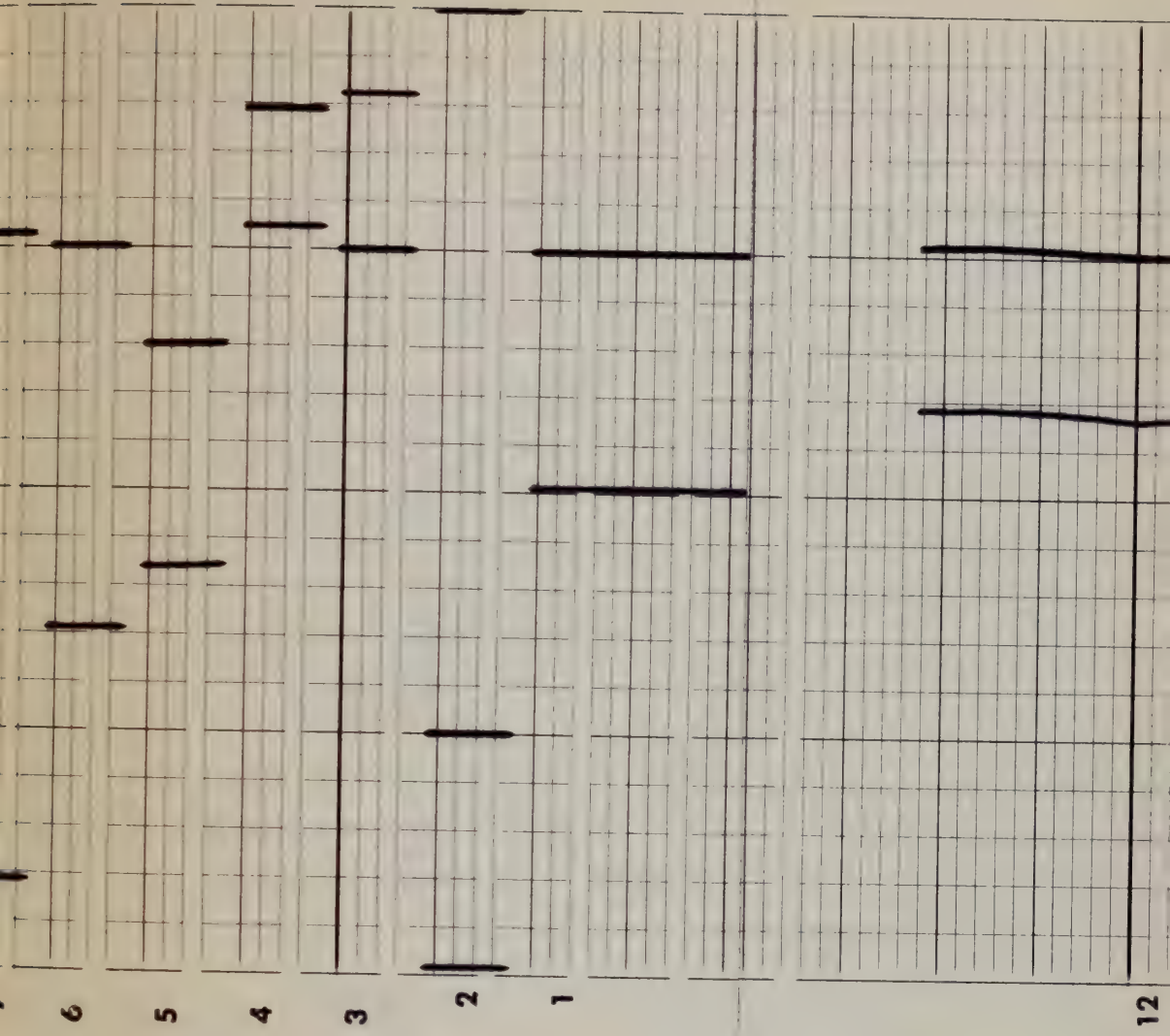
10

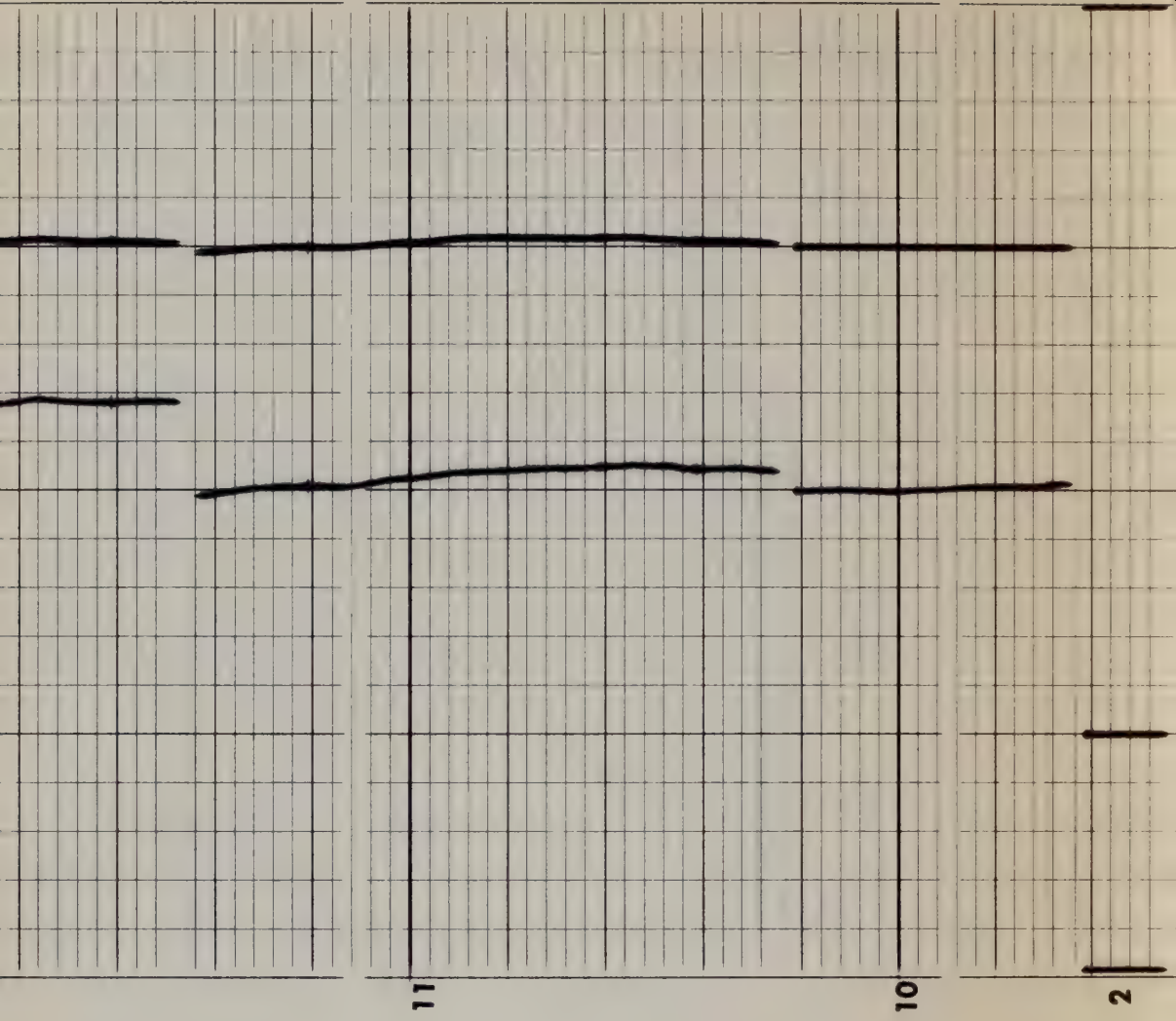
9

8



Shop
Calibration





FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

POS	ρ	$\Delta \rho$
3. # 1	2.92	.00
4. # 2	2.78	+.14
5. # 3	2.42	-.10
6. # 4	2.35	.00
7. # 5	2.08	.01

MECHANICAL ZERO CALIPER

9. 8" RING
10. 12" RING
11. TOOL CALIBRATE # 1 SET $\rho = 2.50$
12. TOOL CALIBRATE # 2 SET $\Delta \rho = .00$
13. LOG POSITION $\rho = 2.59$, $\Delta \rho = .015$

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATE - SOURCE IN PLACE



CALIBRATION RECORD

COMPANY _____ THE ATLANTIC RICHFIELD COMPANY

WELL _____ AQUIFER TEST NO. 1-B

FIELD _____

COUNTY _____ RIO BLANCO STATE _____ COLORADO

SCHL. FR 1640
SCHL. TD 1641
DRLR TD 1638

Elev: KB -----
DF -----
GL 6909

Schlumberger

BOREHOLE COMPENSATED SONIC LOG

COUNTY **RIO BLANCO**
FIELD or LOCATION
WELL **AQUIFER TEST NO. 1-B**
COMPANY **ATLANTIC RICHFIELD**

COMPANY **THE ATLANTIC RICHFIELD COMPANY**

WELL **AQUIFER TEST NO. 1-B**

FIELD **----**

COUNTY **RIO BLANCO** STATE **COLORADO**

LOCATION: API Serial No. **01036**

Sec. **7** Twp. **3S** Rge. **96W**

Other Services:

**DIL ENG. PRO.
FDC-GR
CNL-GR**

Permanent Datum: **GL**; Elev.: **6909**
Log Measured From **GL**, **0** Ft. Above Perm. Datum
Drilling Measured From **GL**

Elev.: K.B. **----**
D.F. **----**
G.L. **6909**

Date	7-21-74					
Run No.	ONE					
Depth—Driller	1638					
Depth—Logger	1642					
Btm. Log Interval	1640					
Top Log Interval	410					
Casing—Driller	8-5/8@ 60			@	@	@
Casing—Logger	72					
Bit Size	7-7/8					
Type Fluid in Hole	WATER					
Dens.	Visc.	410				
pH	Fluid Loss	8.3	ml	ml	ml	ml
Source of Sample						
R _m @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mf} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mc} @ Meas. Temp.	@	°F	@	°F	@	°F
Source: R _{mf} R _{mc}						
R _m @ BHT	@	°F	@	°F	@	°F
TIME	Circulation Stopped					
	24 HRS.					
Max. Rec. Temp.	90	°F	°F	°F	°F	°F
Equip.	Location	5602 G.J.				
Recorded By	SCHNORR					
Witnessed By	TAIT					

Run No.	ONE				
Service Order No.	01036				
Fluid Level					

EQUIPMENT DATA					
Sonic Panel No.	JD-439				
Sonic Cart No.	A-166				
Sonic Sonde No.	D-499				
Mem. Panel No.	B-260				
G.R. Cart. No.	----				
G.R. Panel No.	----				
Caliper No.	VCD-D-851				
TTR No.	----				
Centralizers: No.	CALIPERM	RUBBER	STANDOFF	&	SPRING
Type					
Standoffs: No.	1-1/2"				
Type					
Time Const.-Sec.	----				
Speed - F.P.M.	----				

CALIBRATION DATA			
GR	BKG. CPS		
	Source CPS		
	Tc Sec		

All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Clause 7 of our General Terms and Conditions as set out in our current Price Schedule.

CALIPER	DIAM. IN INCHES
6	16

DEPTH

INTERVAL TRANSIT TIME	MICROSECONDS PER FOOT	T	3	R ₁	2	R ₂
150	100					50
250	200					150

SCALE CHANGES			
Type Log	Depth	Scale Up Hole	Scale Down Hole

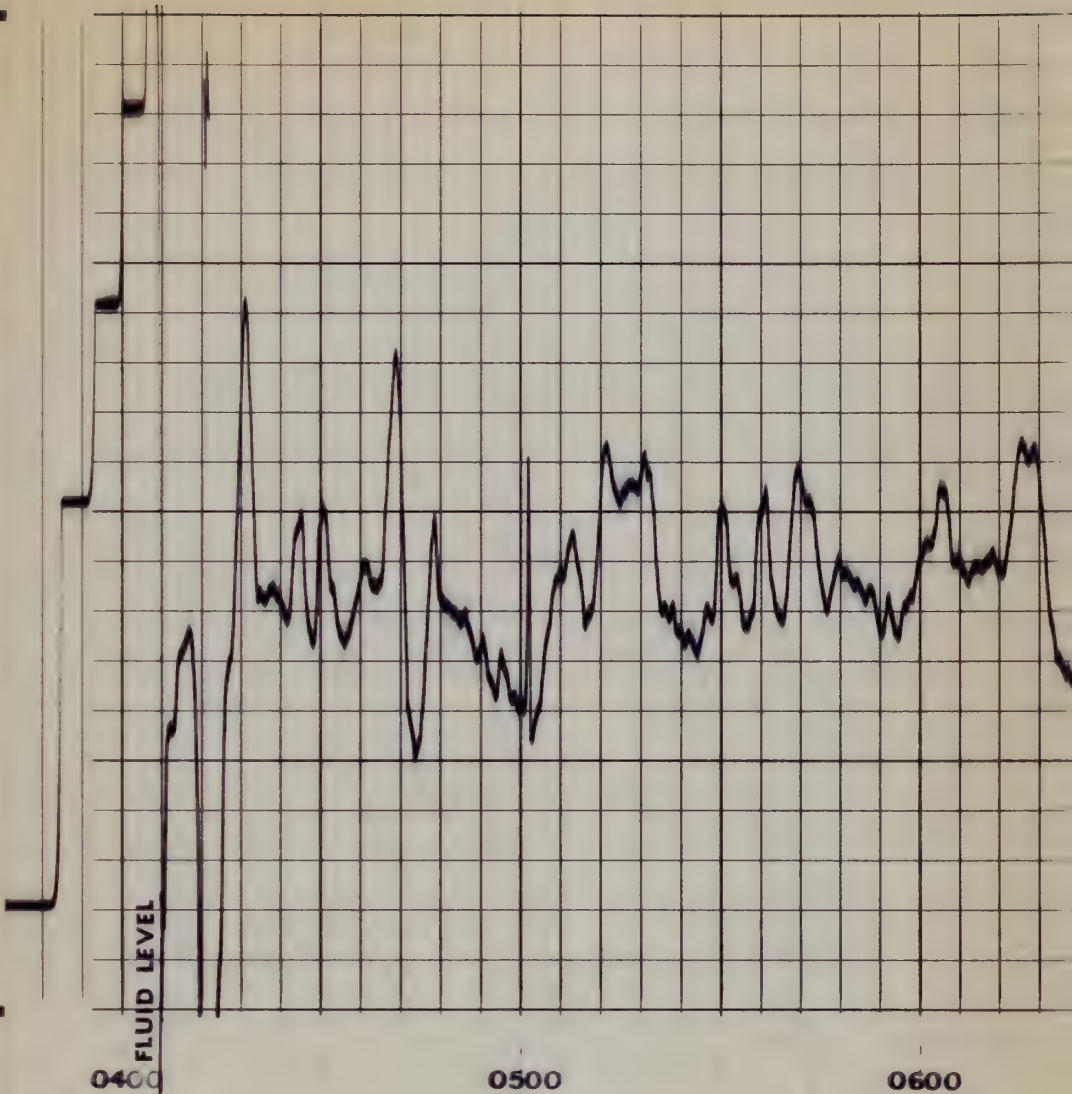
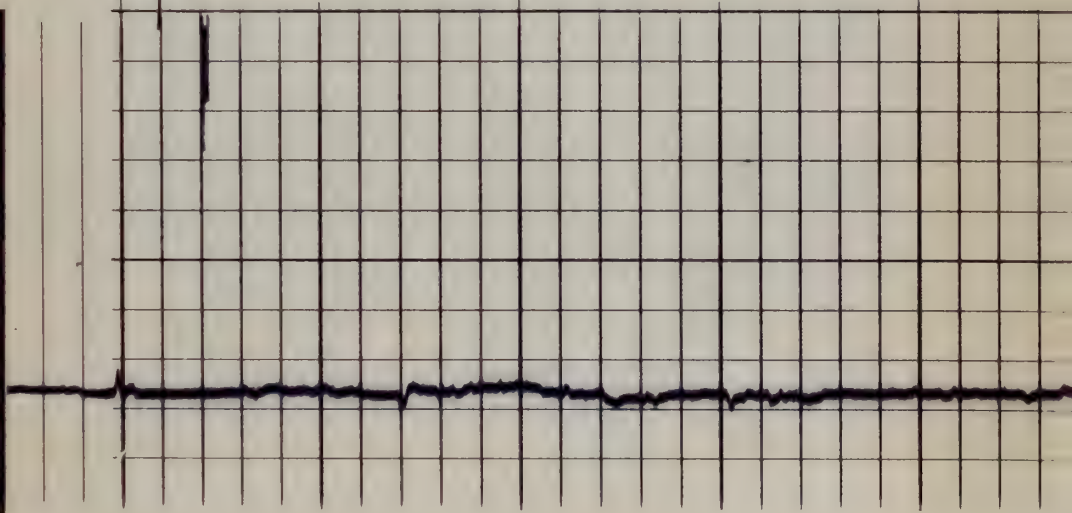
LOGGING DATA				
Porosity Selectors			Depth	
Δt_m	Δt_f	Cp	ϕ Scale	From To

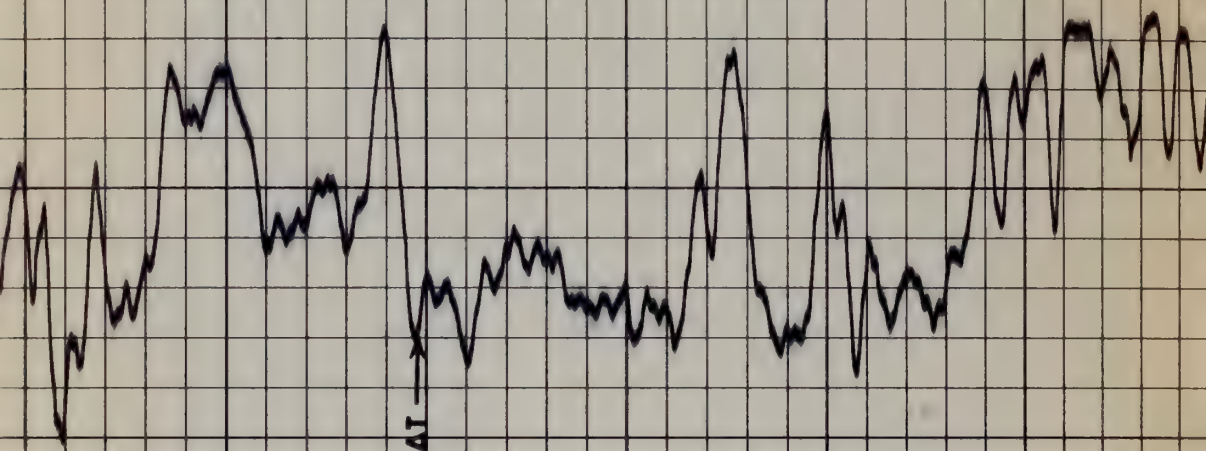
REMARKS
Velocity (ft/sec) = 1,000,000 Interval Transit Time (microseconds per foot)

GAMMA RAY

API UNITS

0150150300

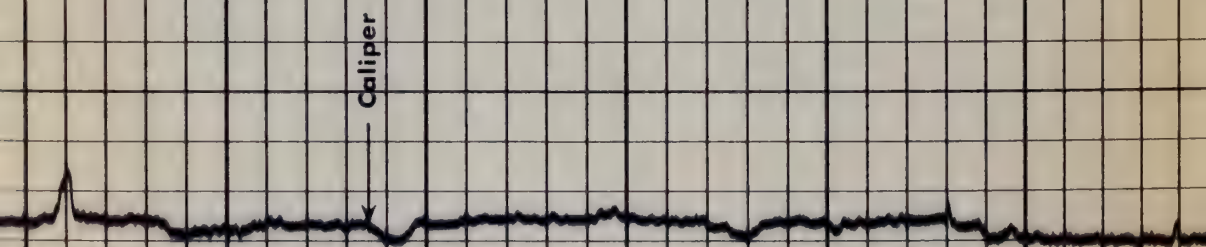




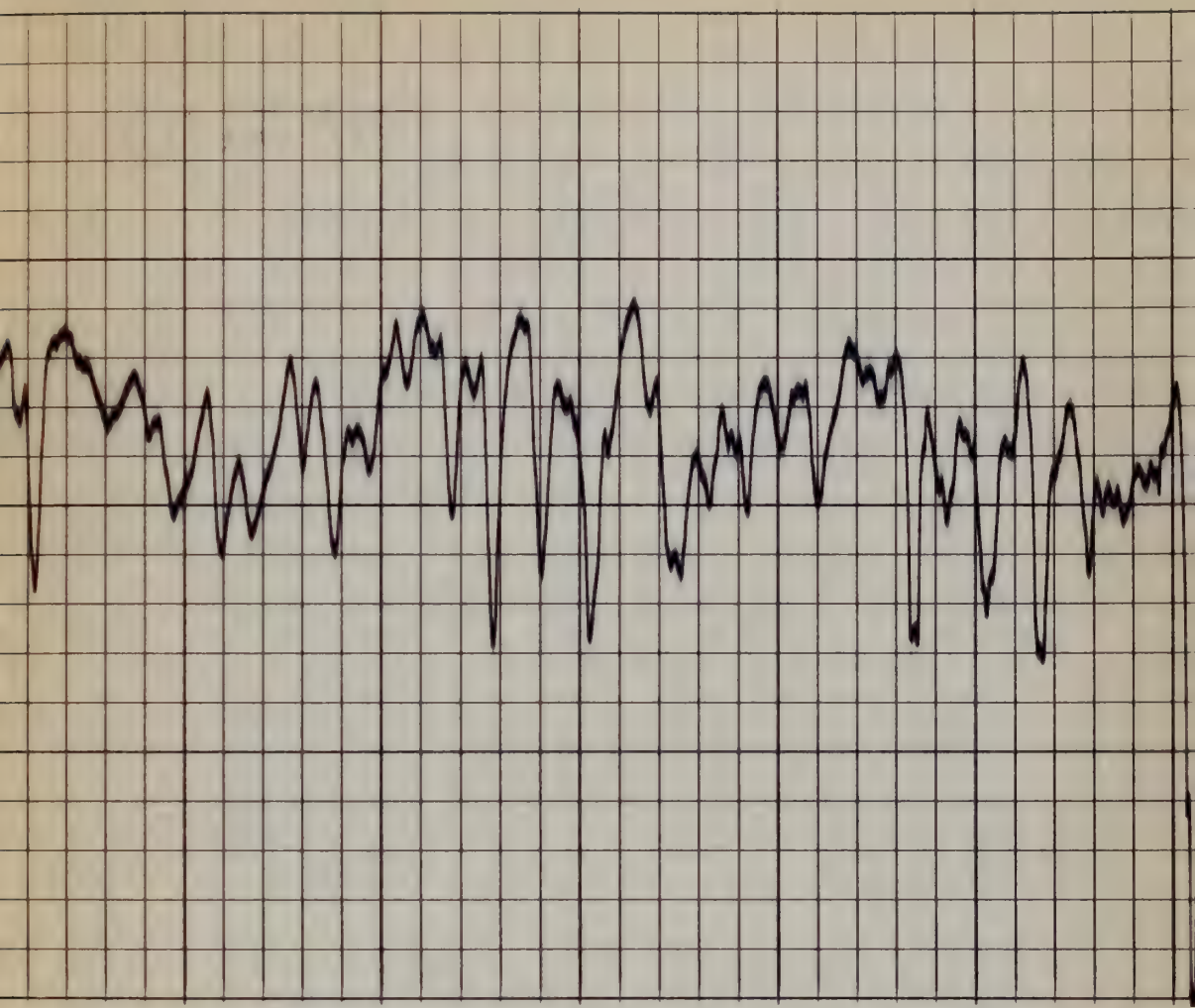
0700

0800

0900



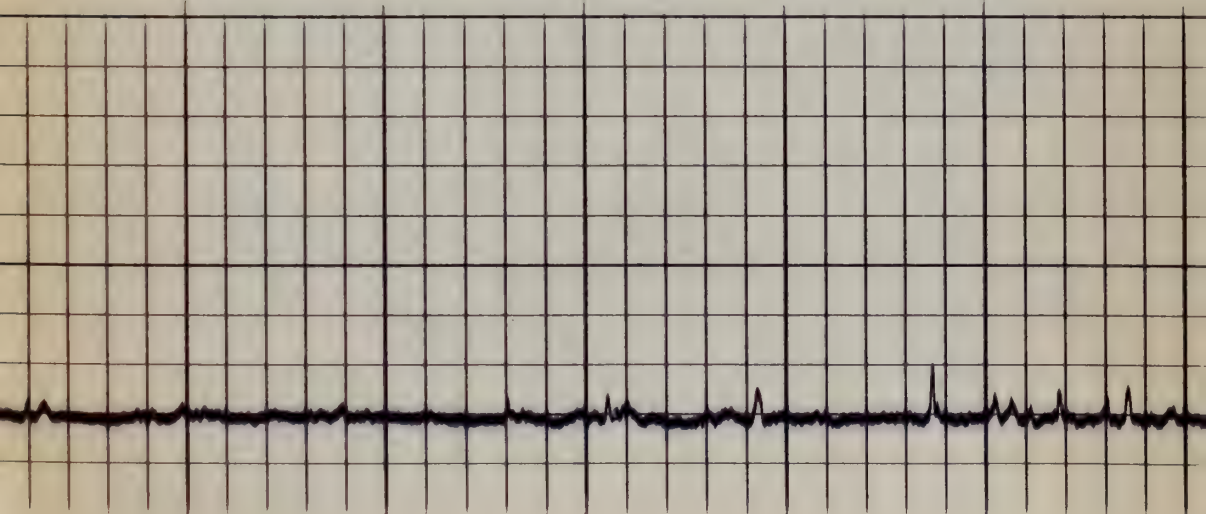
Caliper

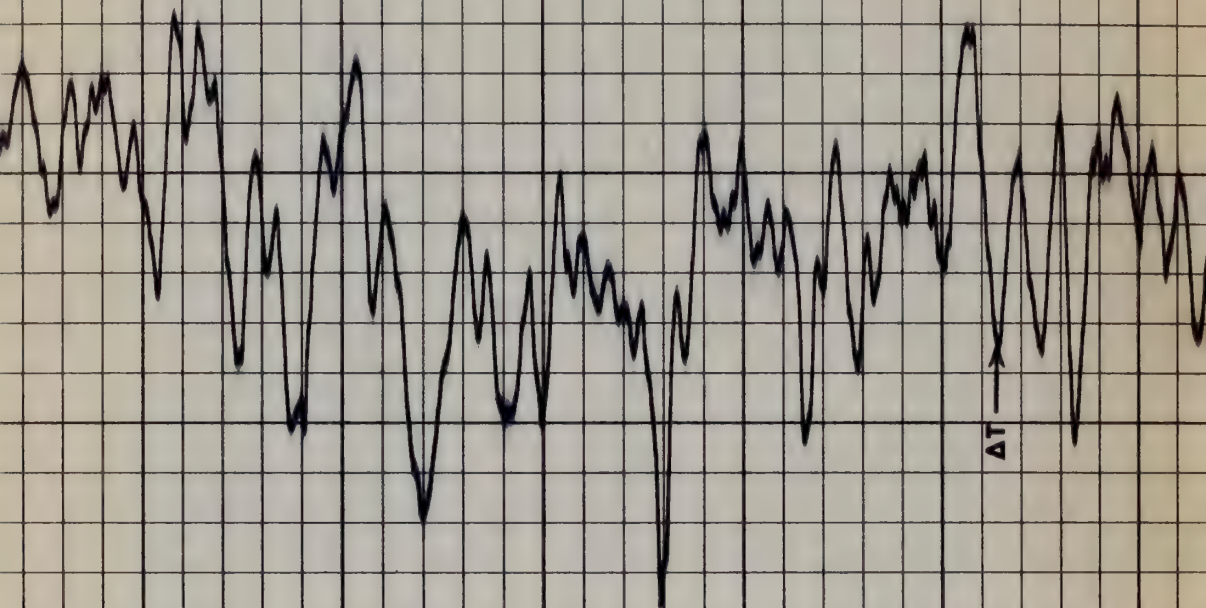


1000

1100

1200





1300

1400

1500

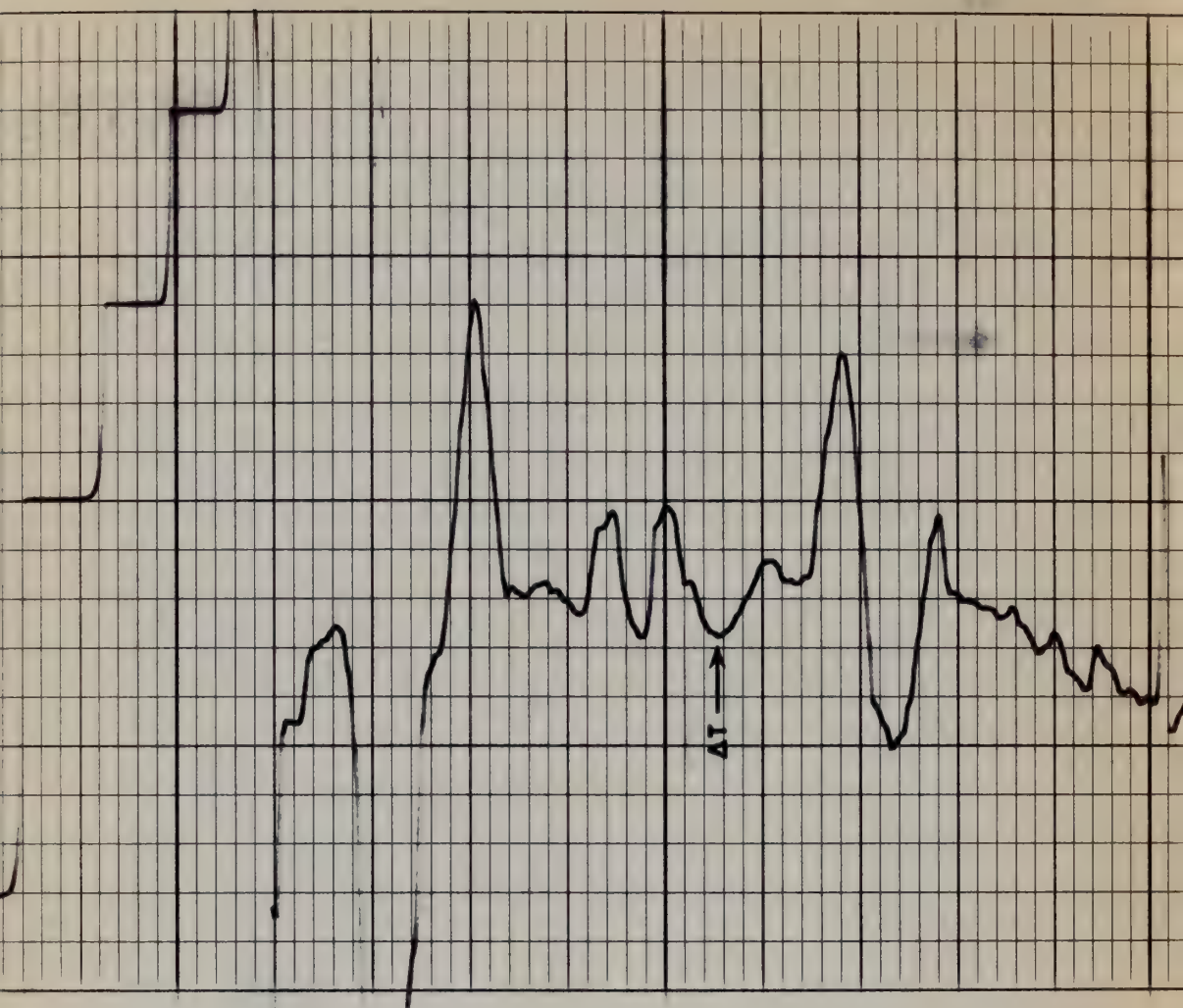
Caliper



1600

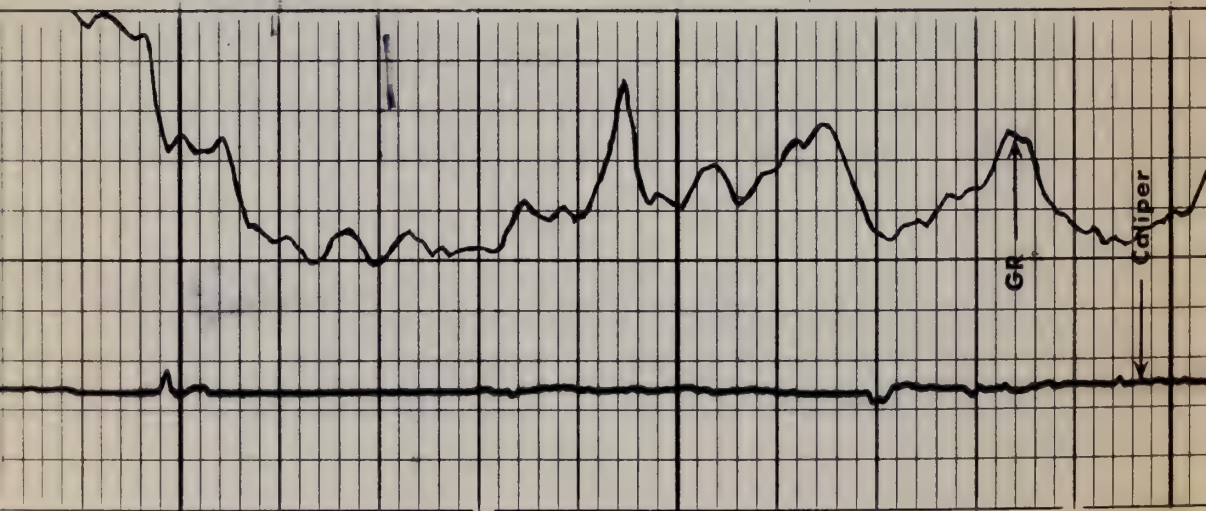
 $5'' = 100'$

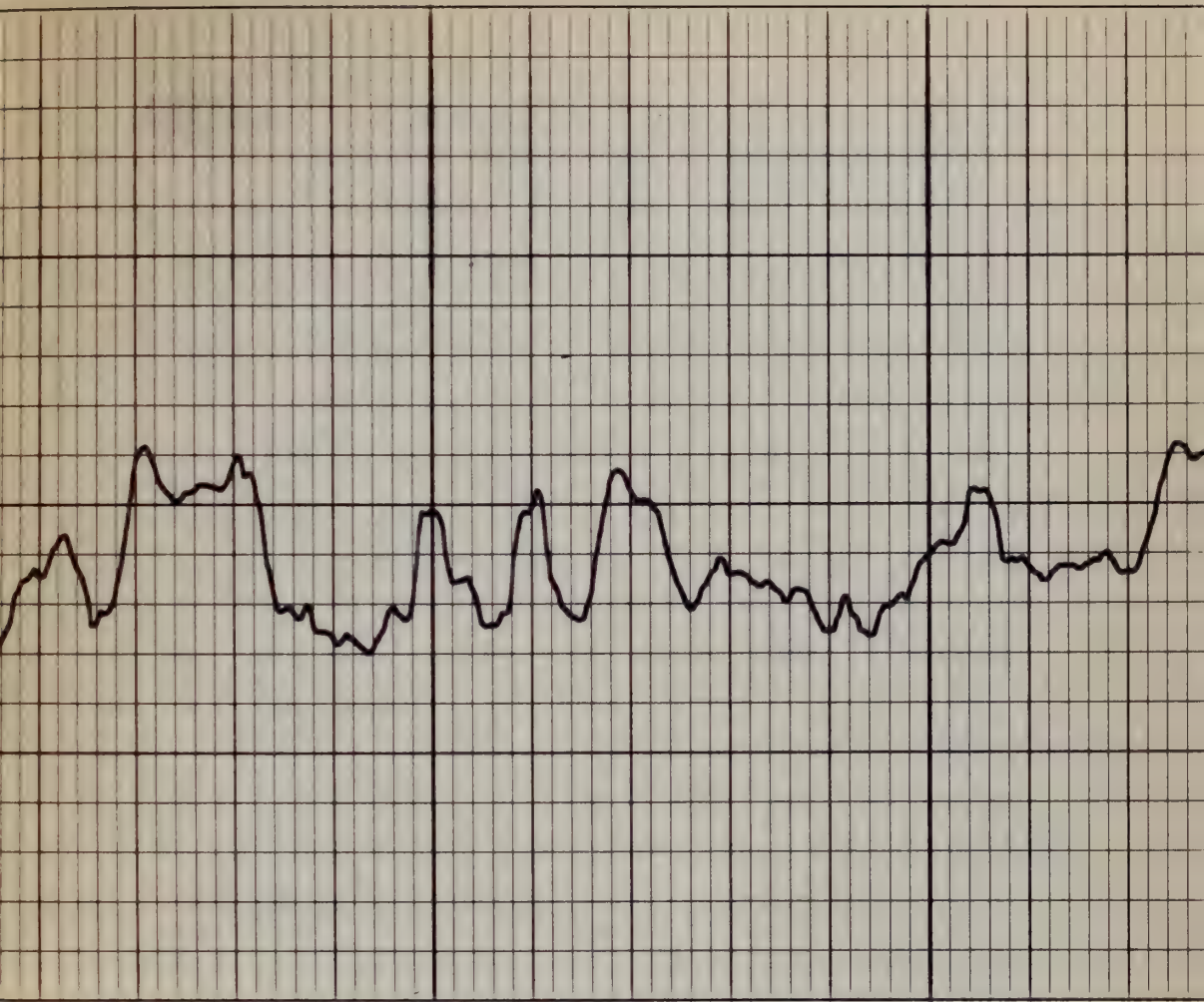
GAMMA RAY API UNITS		DEPTHS	INTERVAL TRANSIT TIME MICROSECONDS PER FOOT
0	150		$T = \frac{3R_1 + 2R_2}{100}$
150	300		150
CALIPER HOLE DIAM. IN INCHES			
<div> <div>6</div> <div>16</div> </div>			



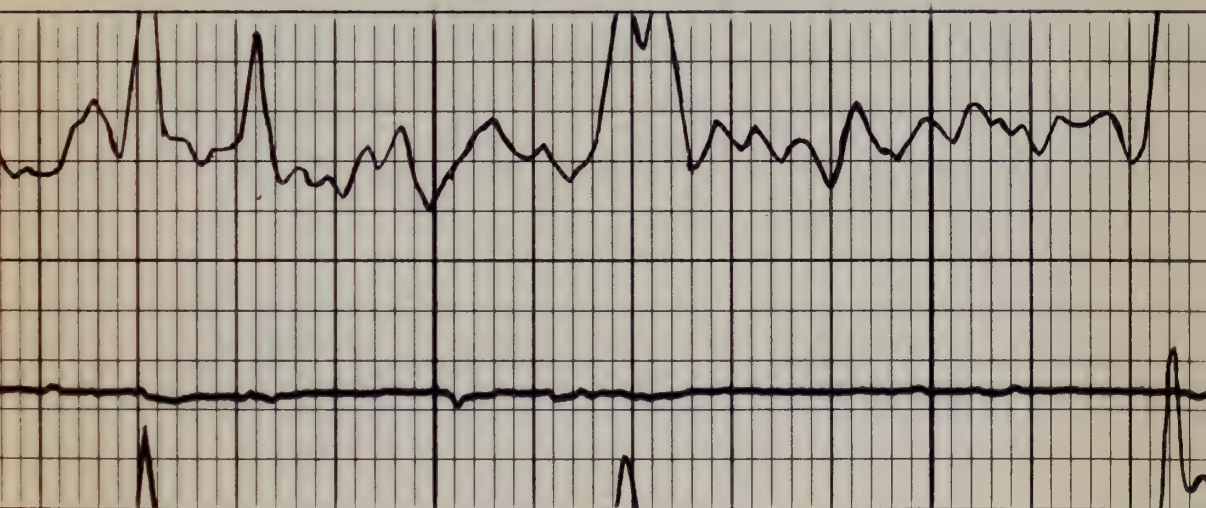
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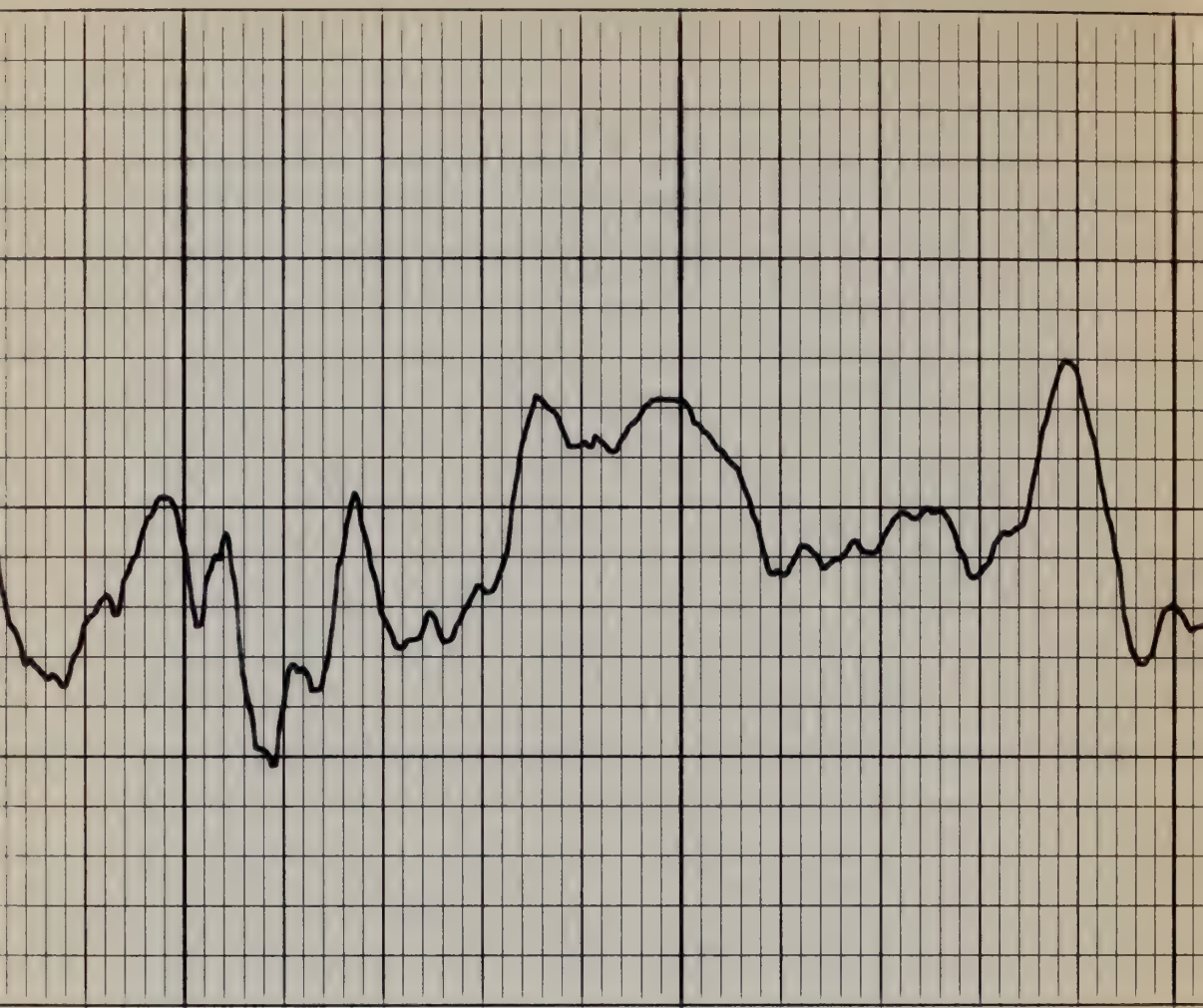
0500



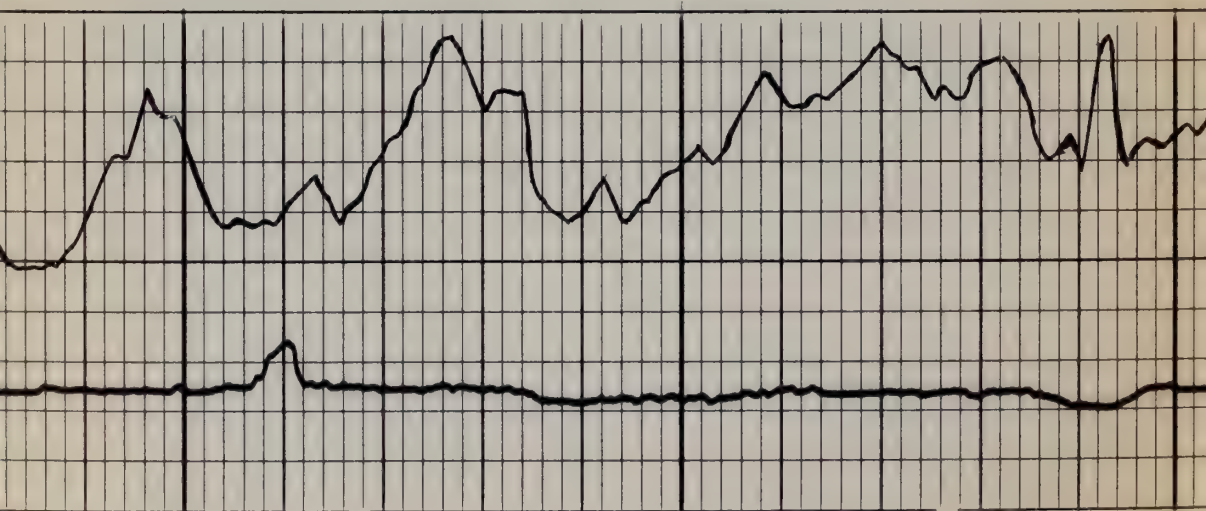


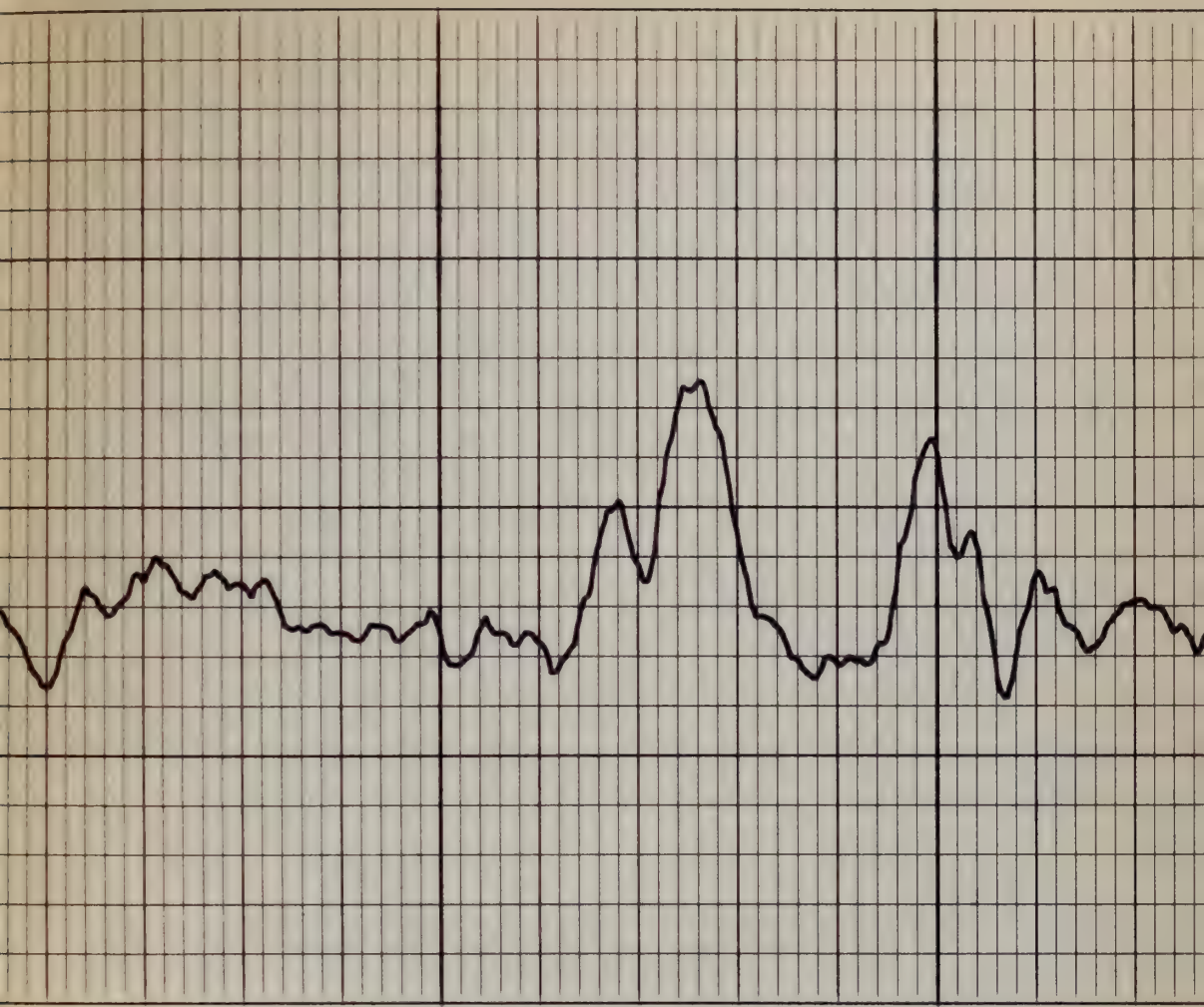
0600



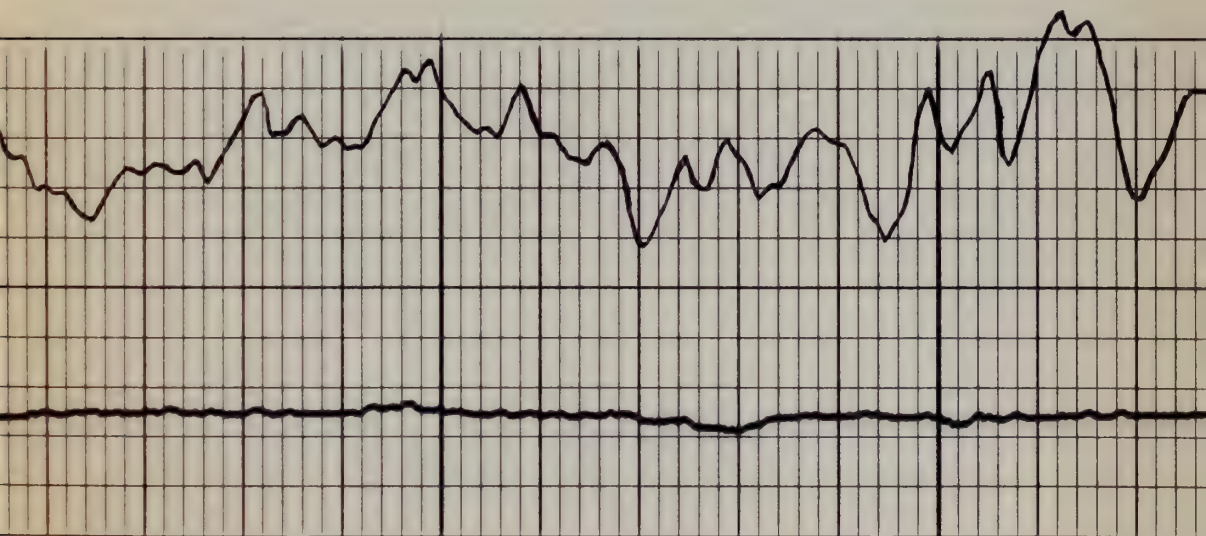


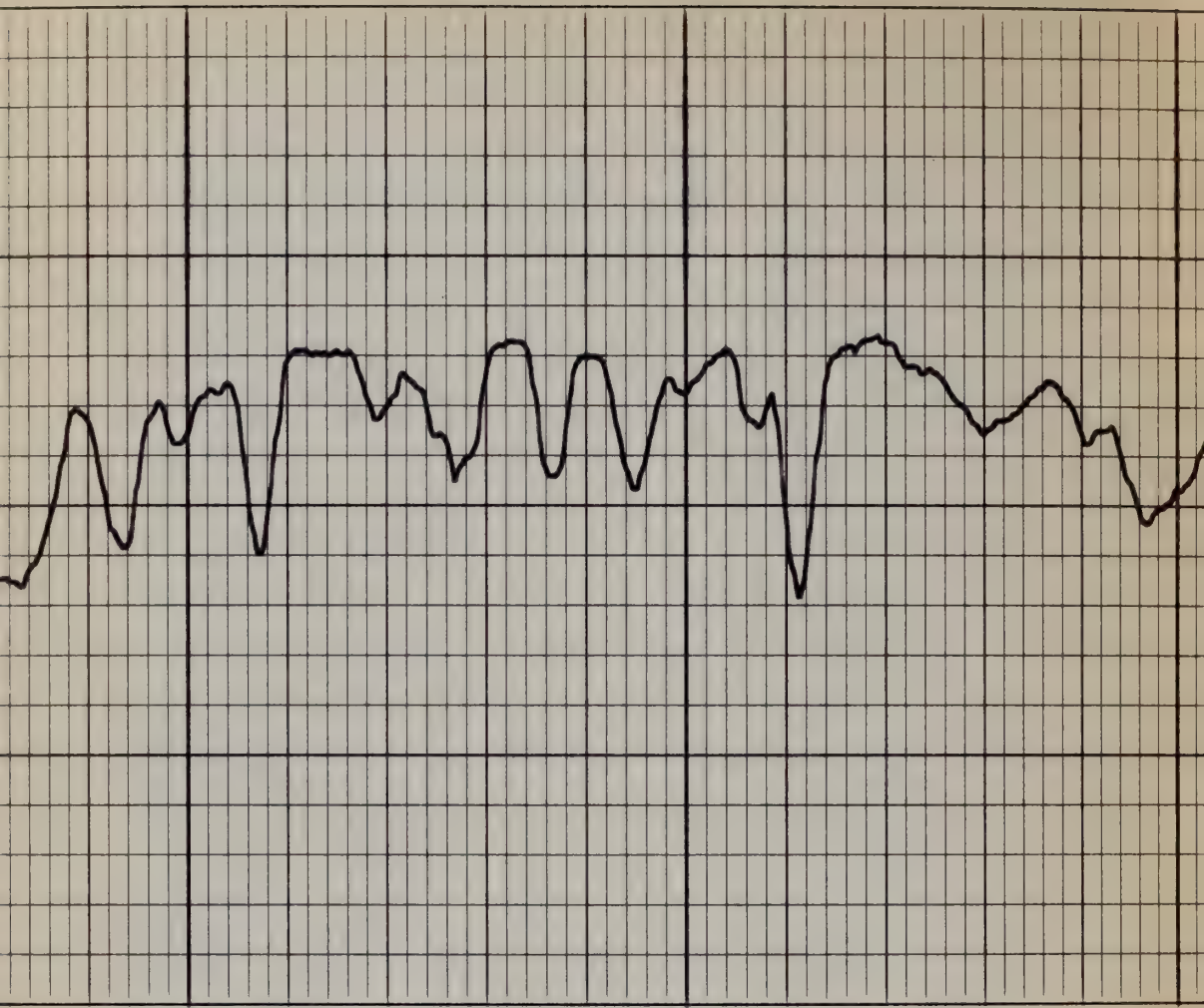
0700





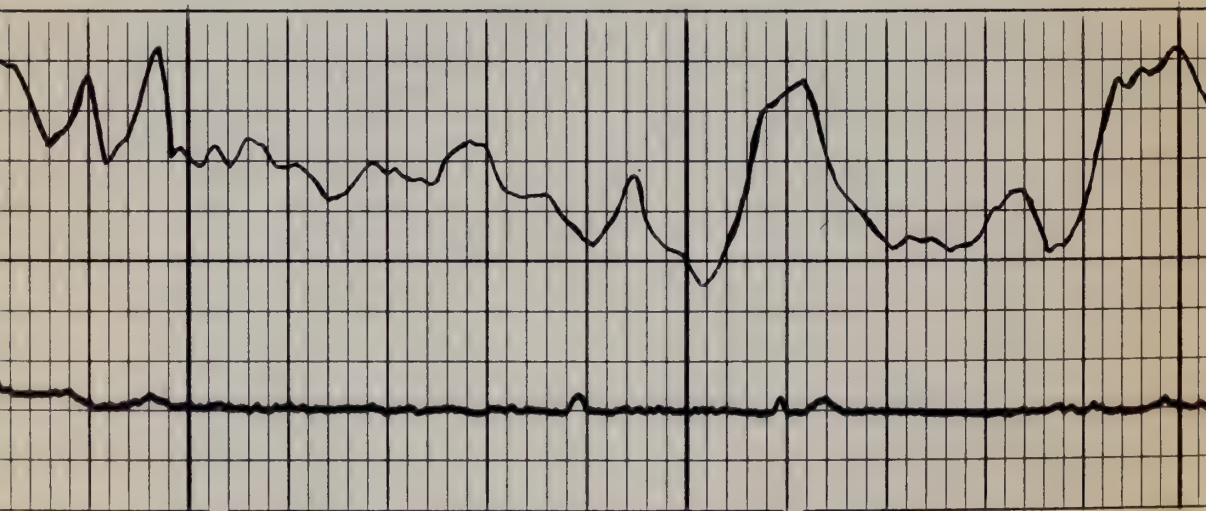
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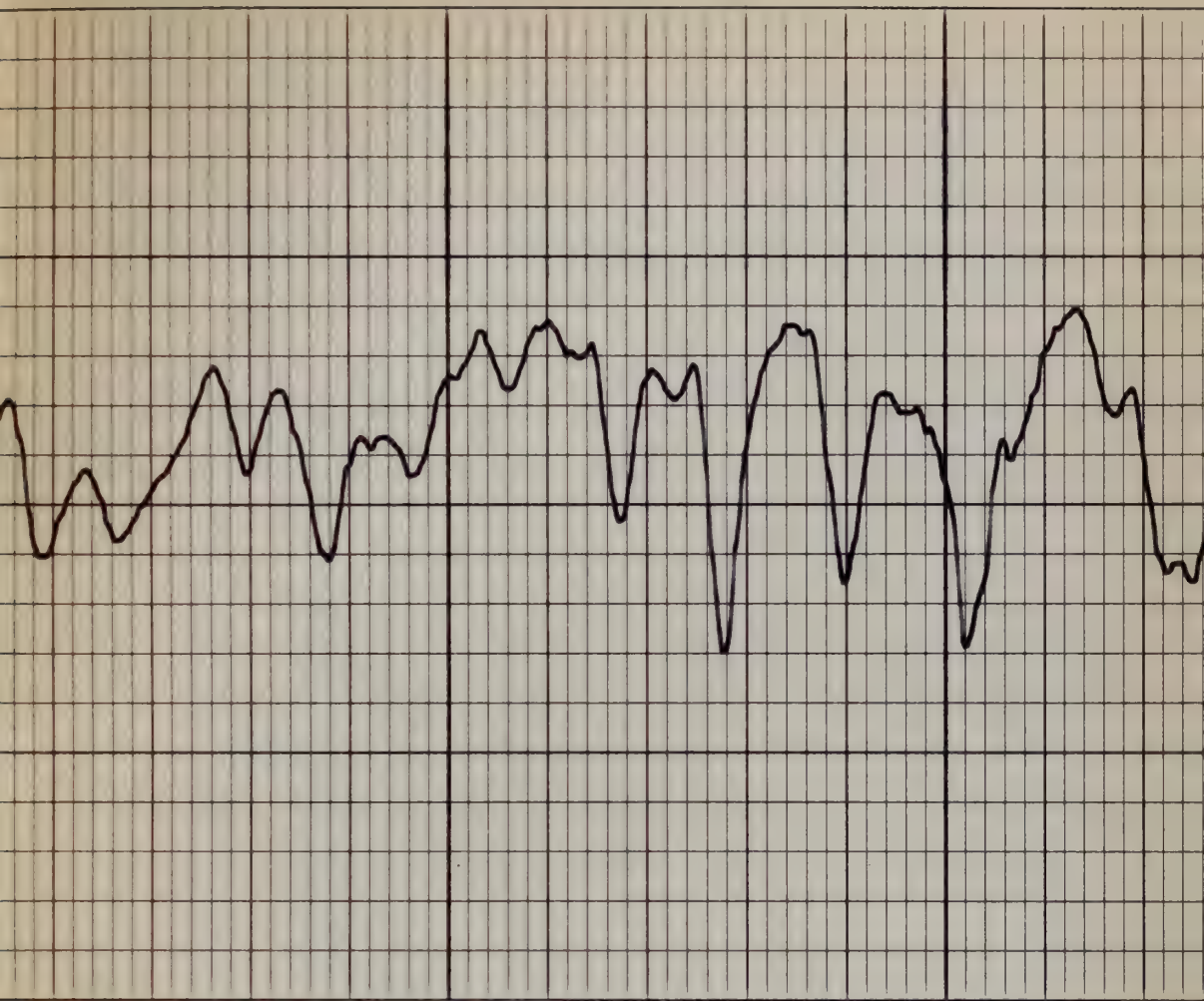




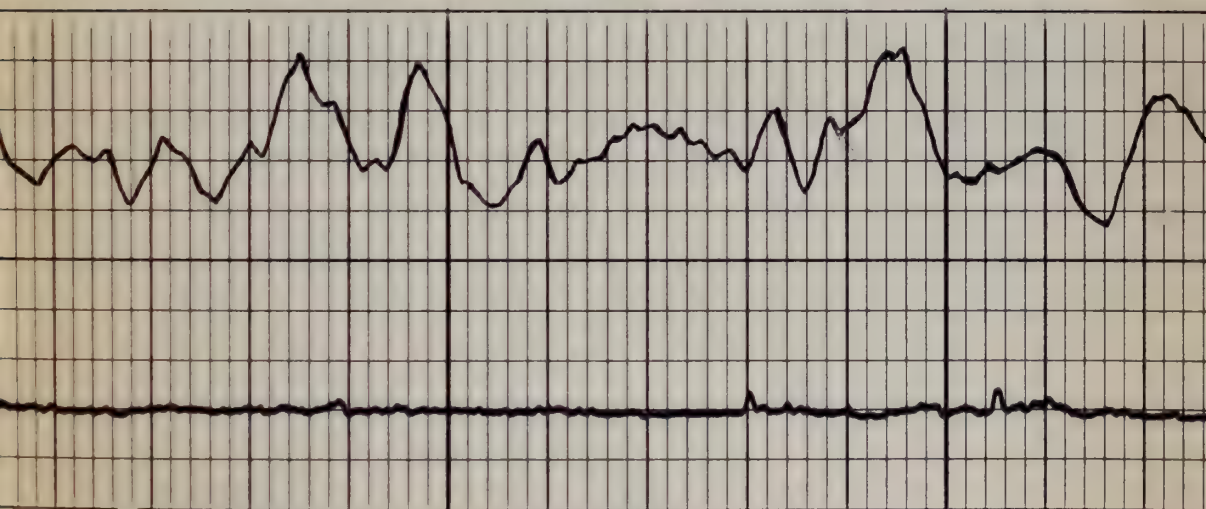
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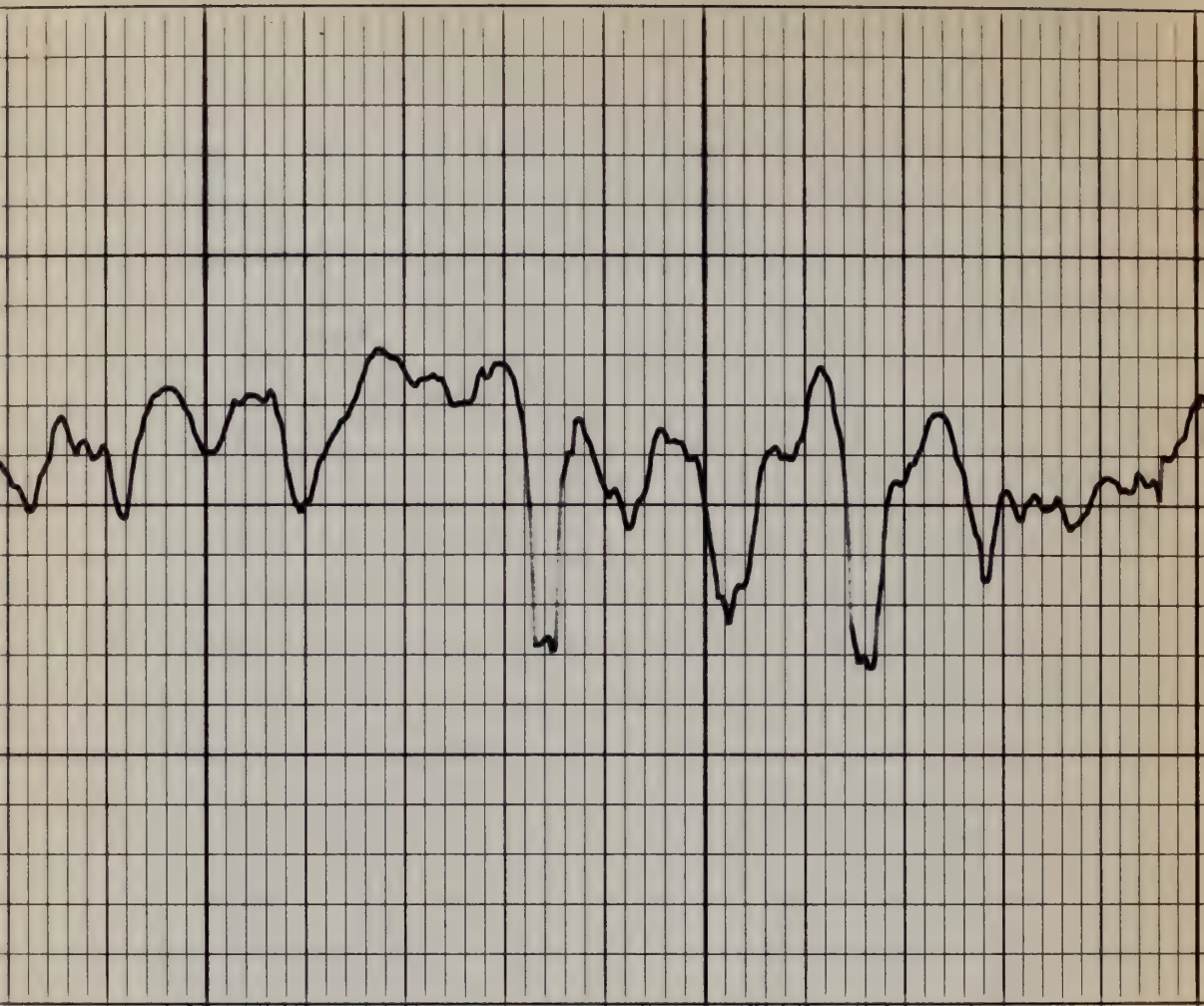
1000



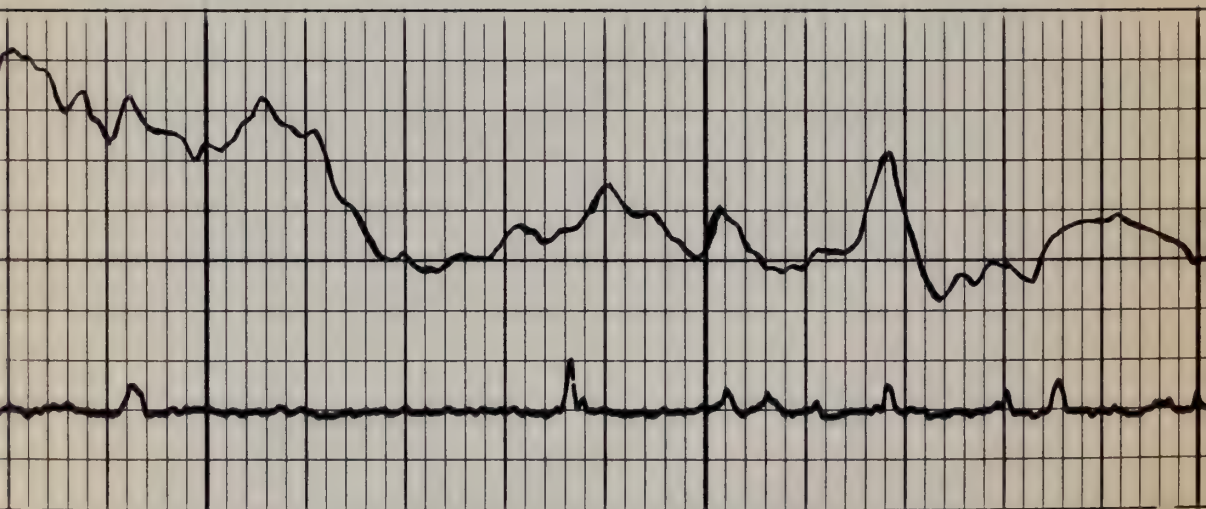


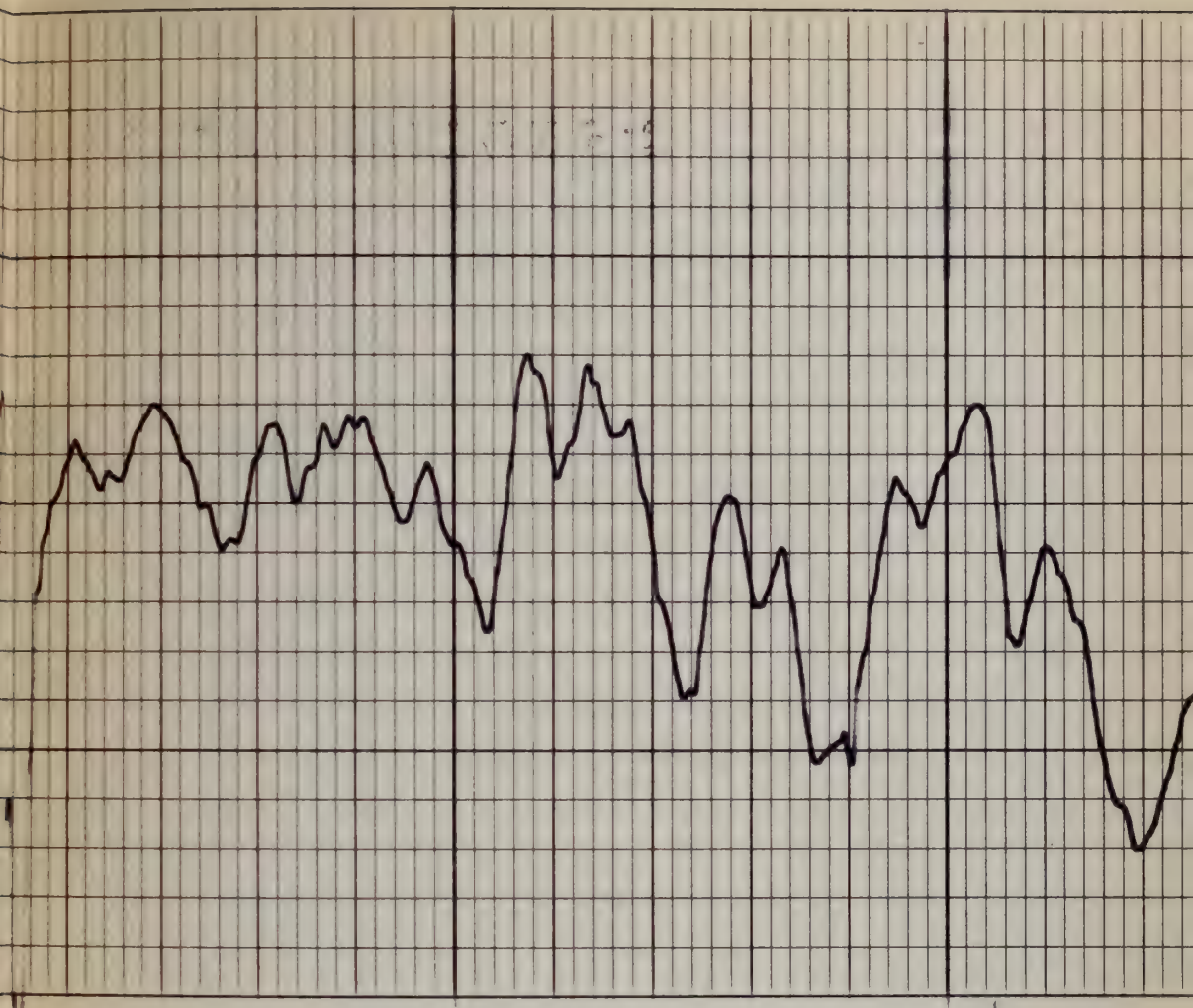
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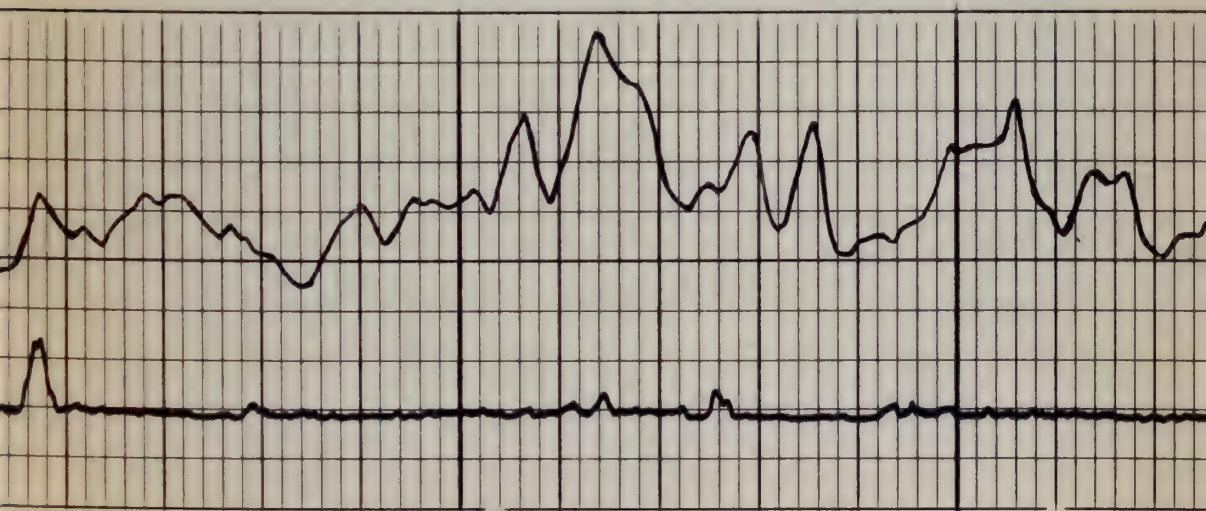


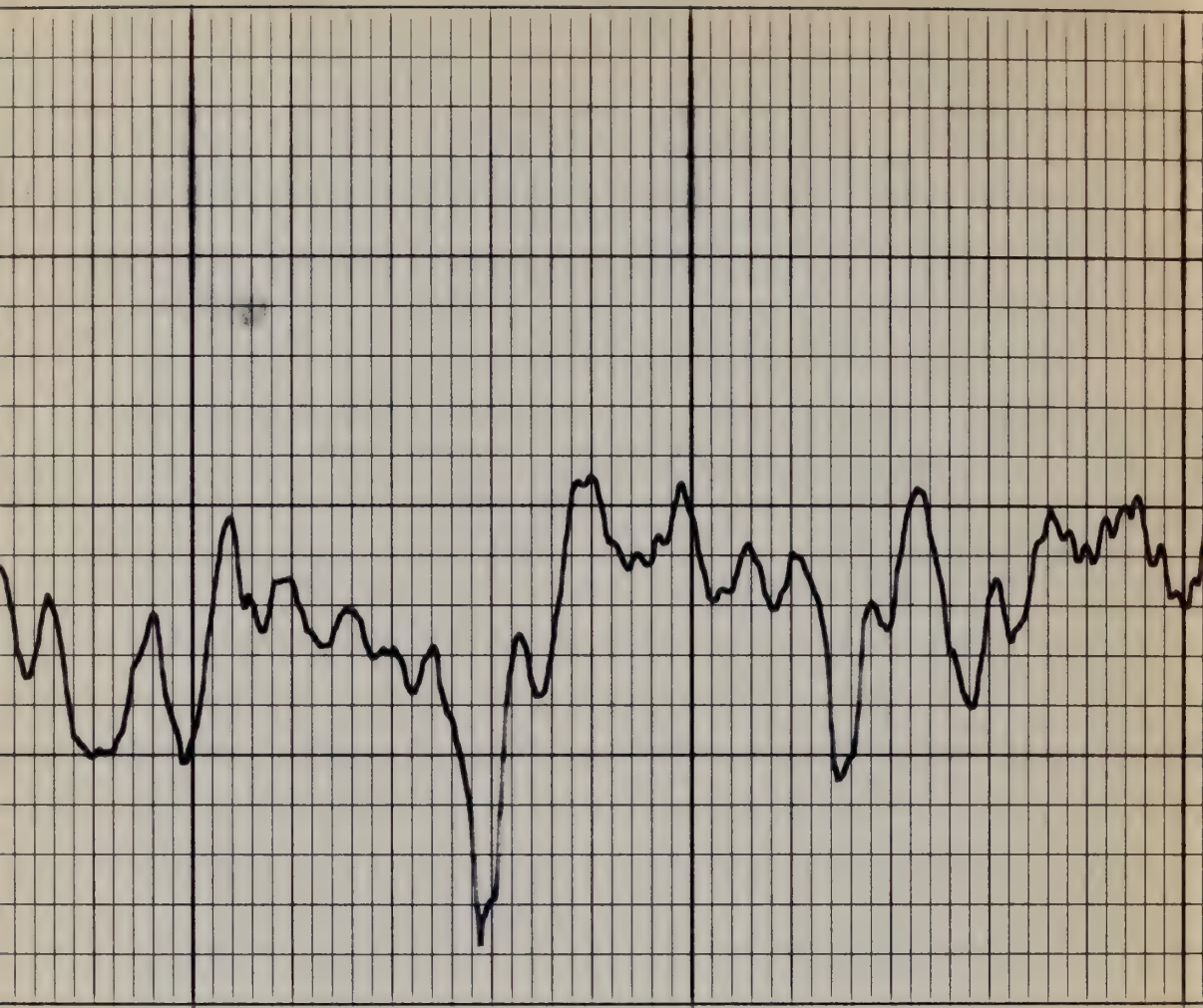
1200





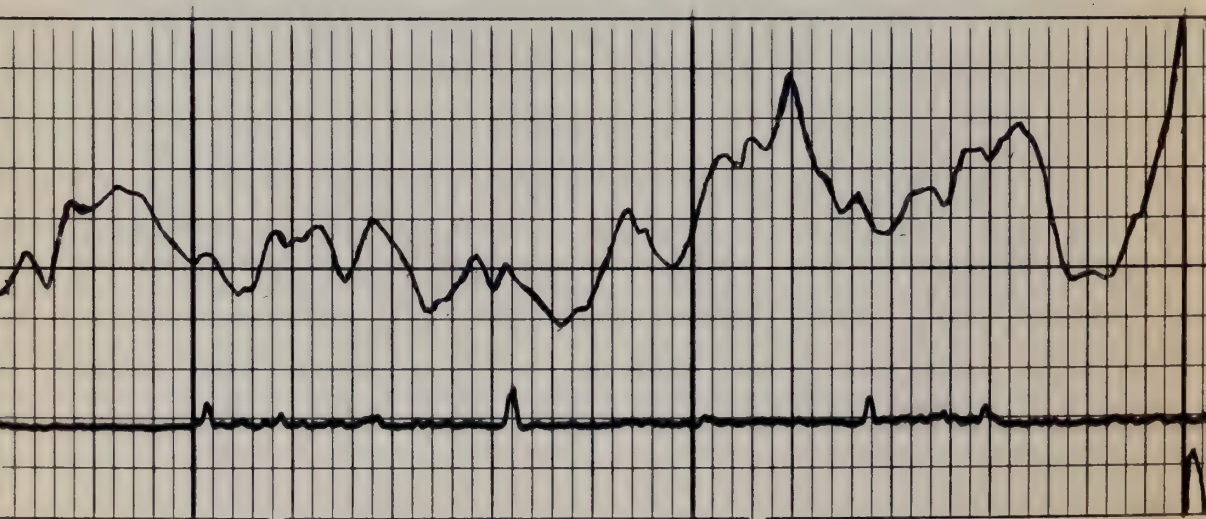
1300

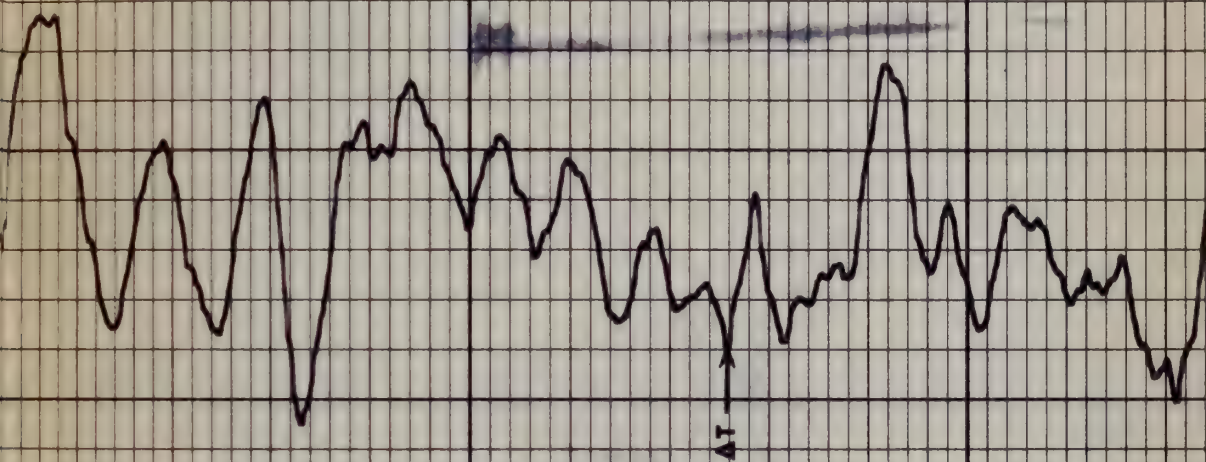




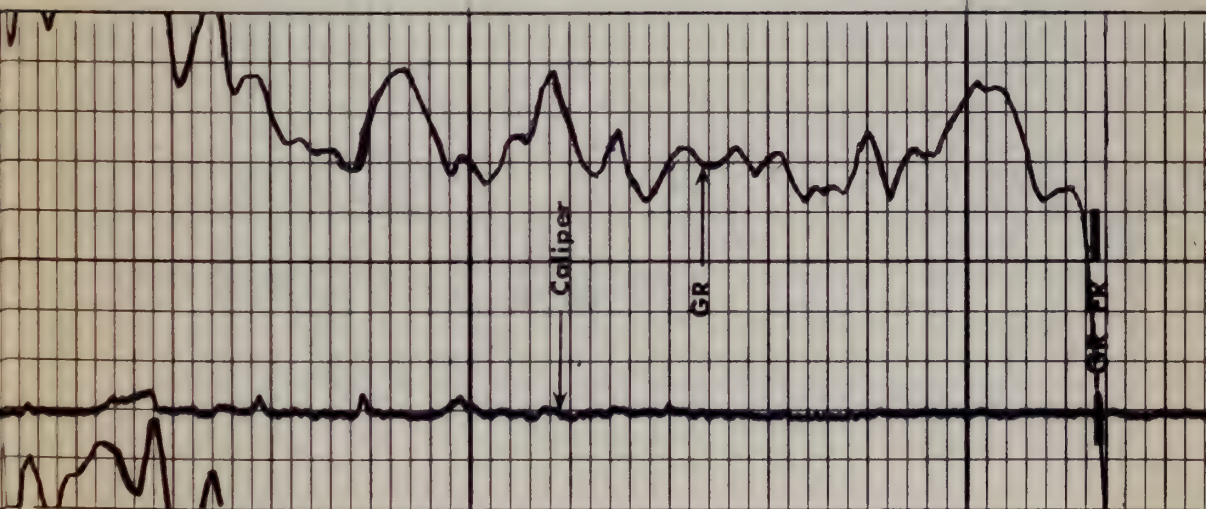
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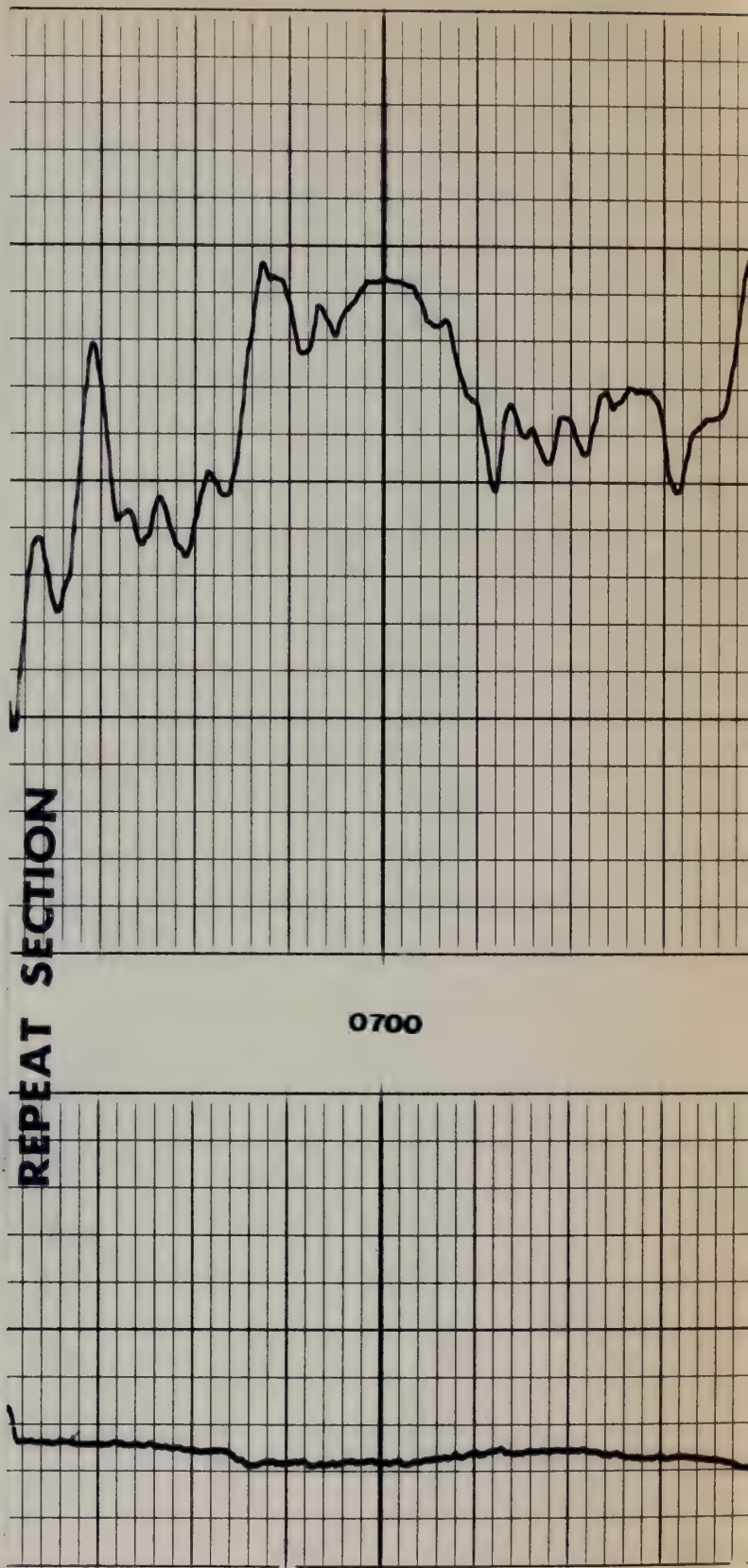
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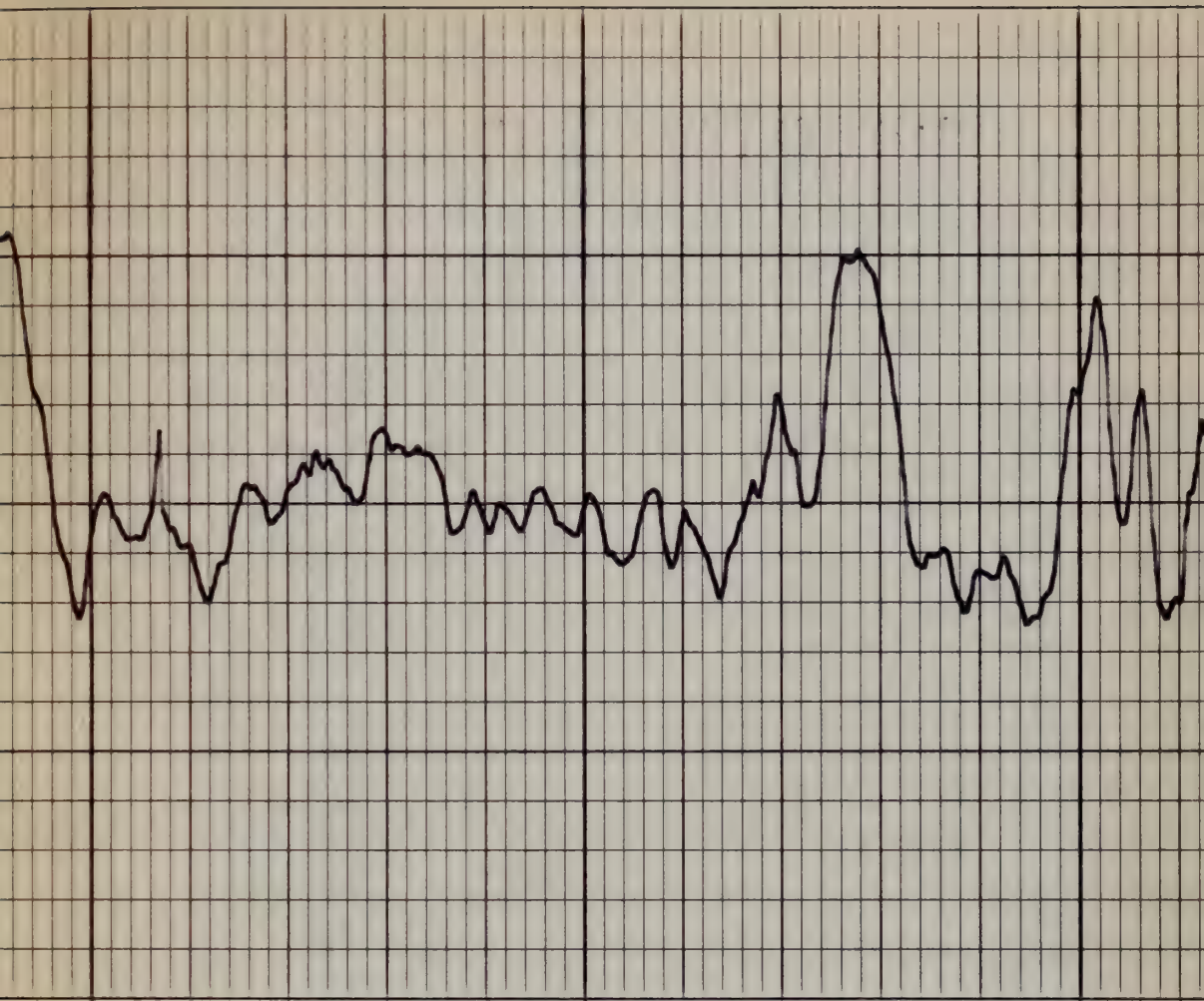




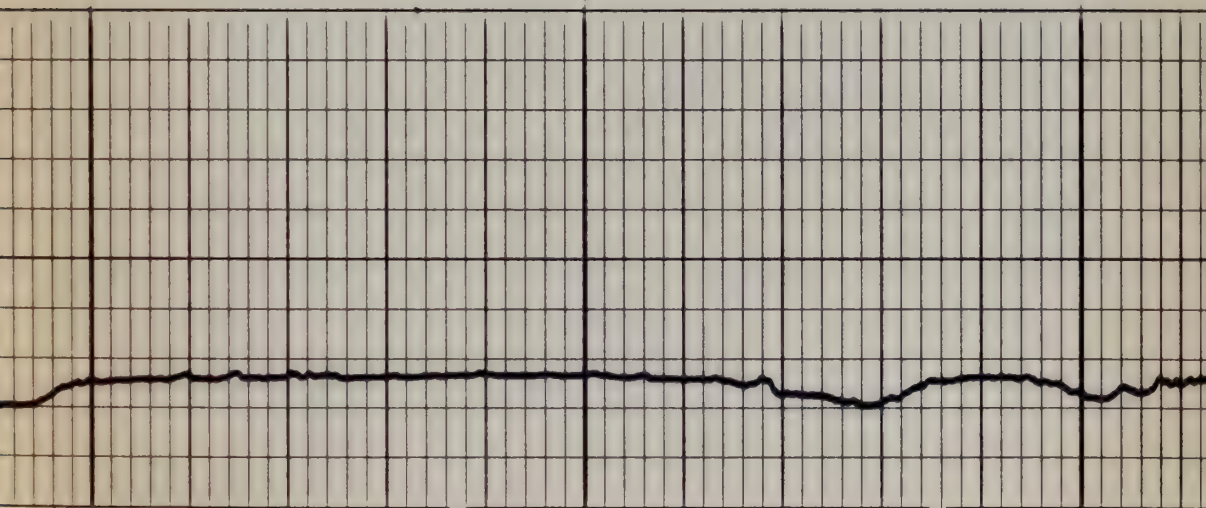
1600

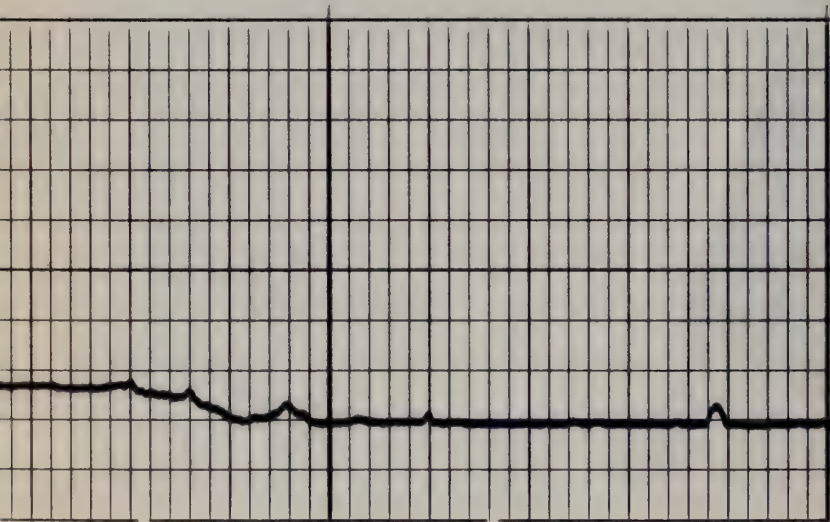




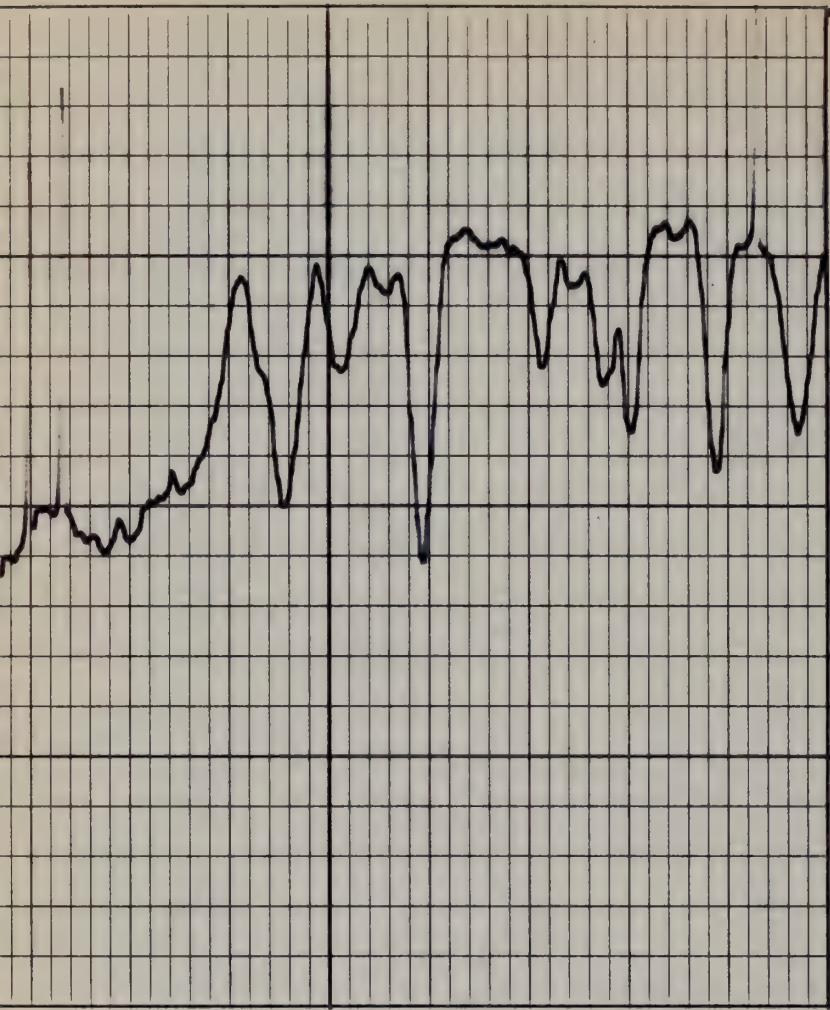


0800





0900



16

6

CALIPER

HOLE DIAM. IN INCHES

T 3 R₁ 2 R₂

CALIPER	
U	150
150	300

150	300
250	150

GAMMA RAY	
API UNITS	

INTERVAL TRANSIT TIME	
MICROSECONDS PER FOOT	

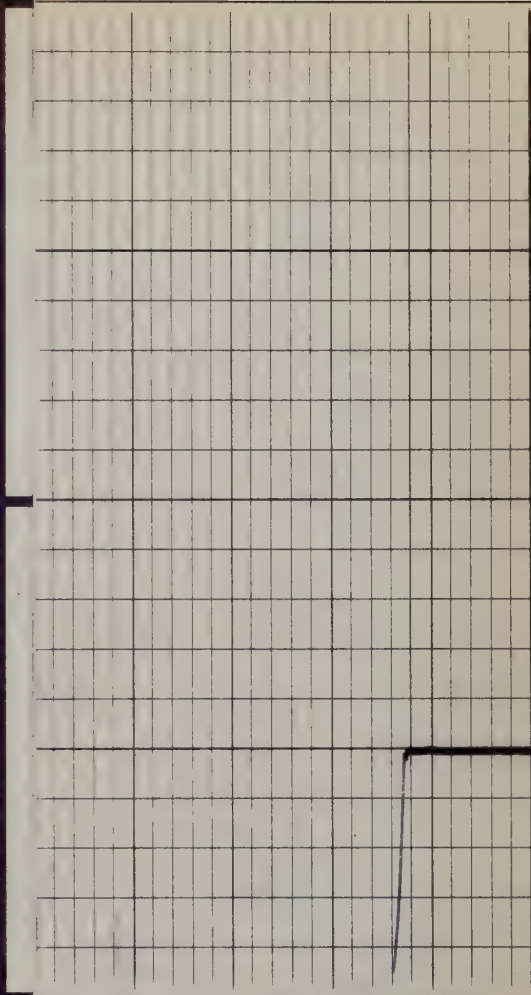
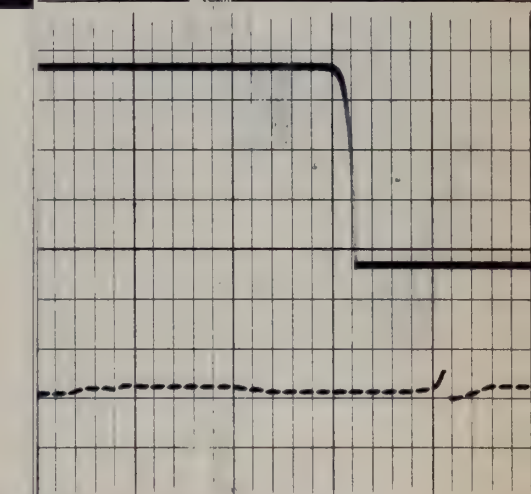
DEPTHS

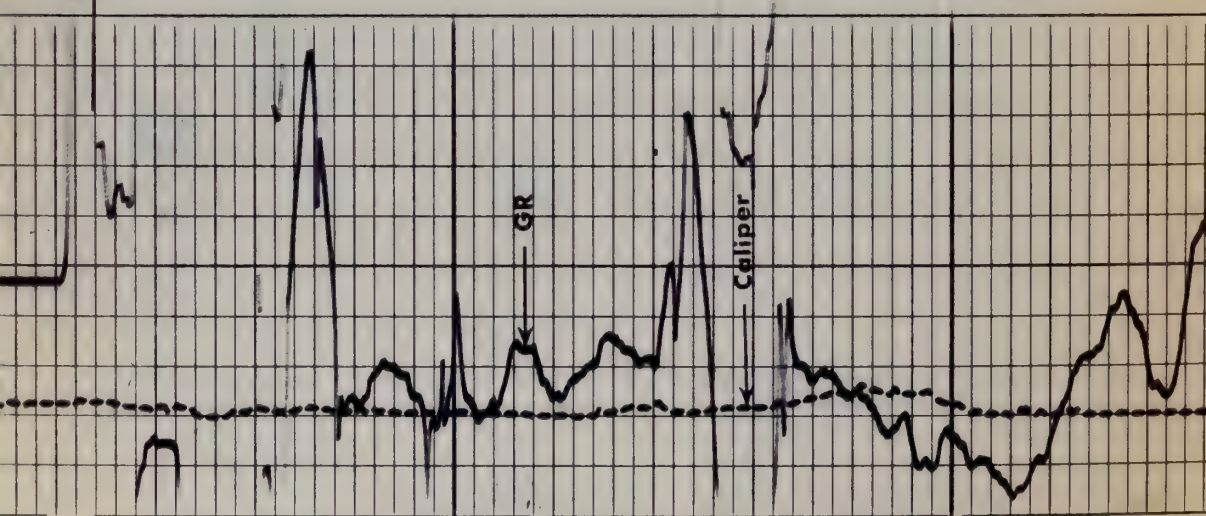
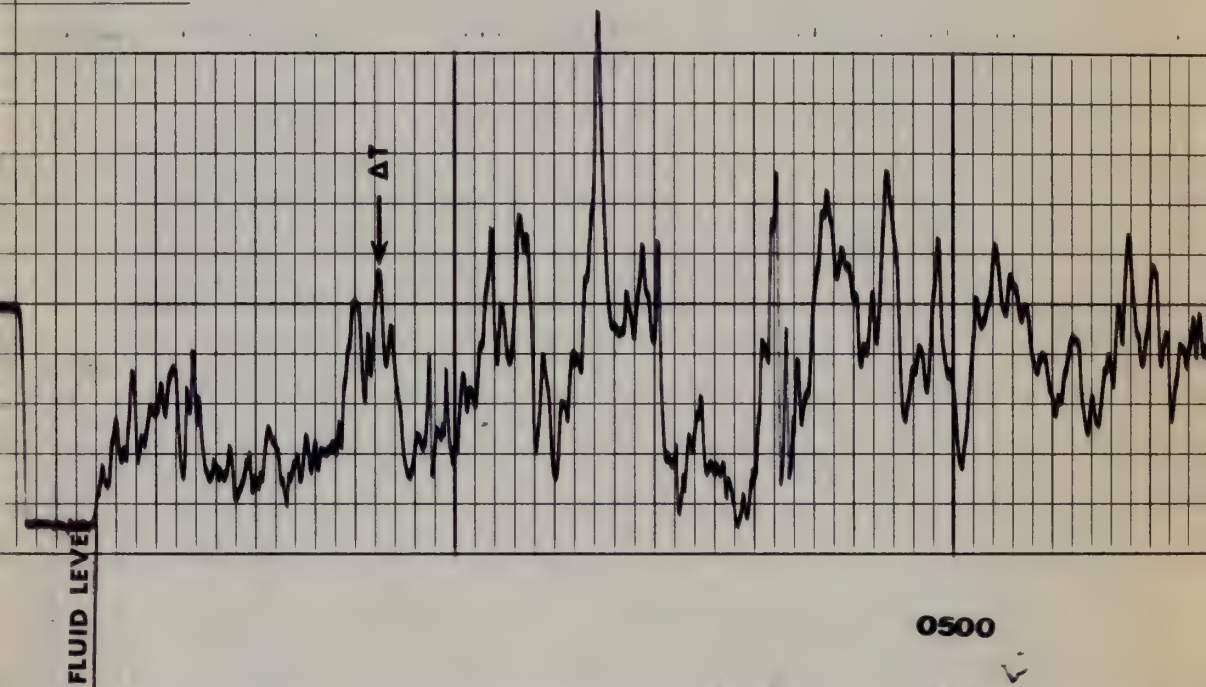
SINGLE AT RECEIVER	
TIME	
MICROSECONDS	

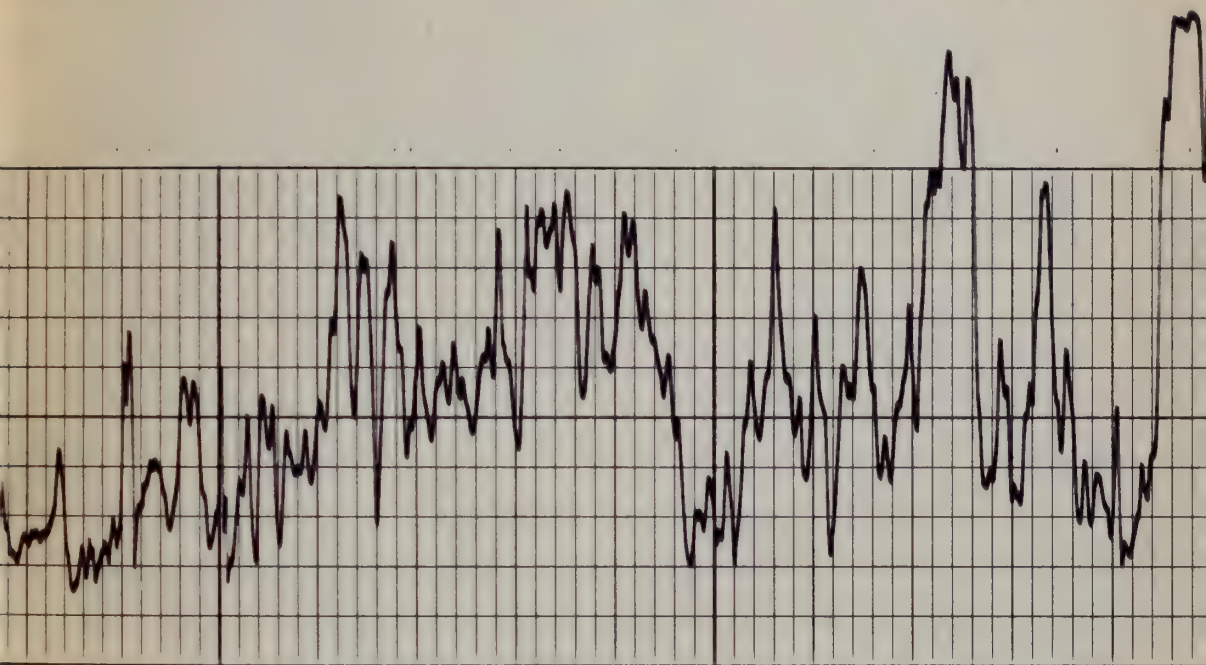
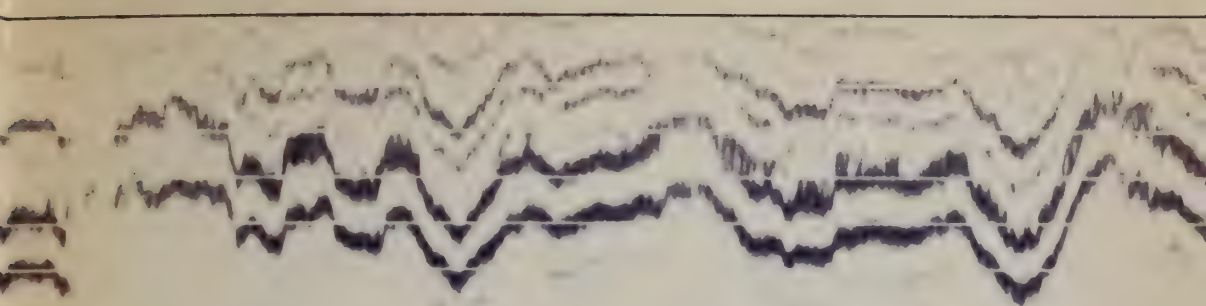
--	--

495	295
6	CALIPER
	16

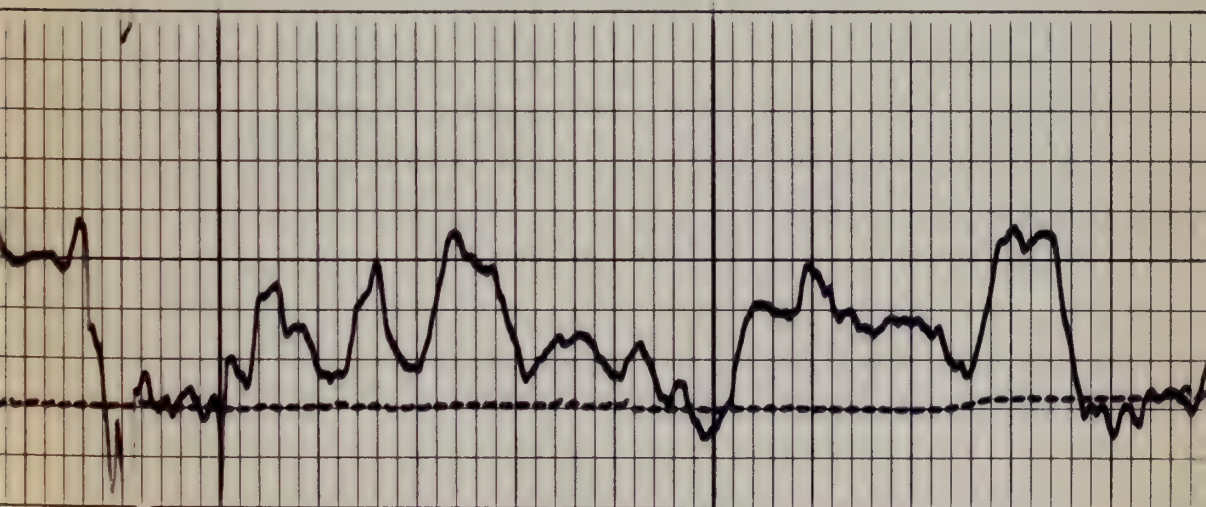
AMPLITUDE	
MILLIVOLTS	
0	20
VARIABLE DENSITY	
MICROSECONDS	
200	1200

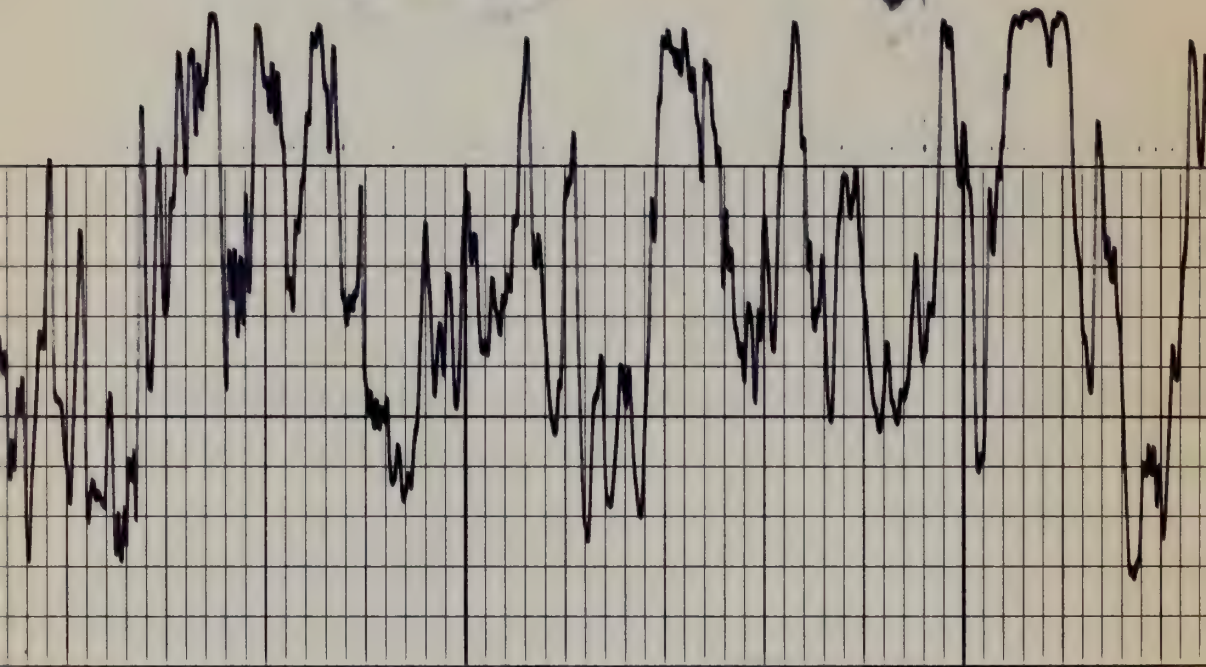
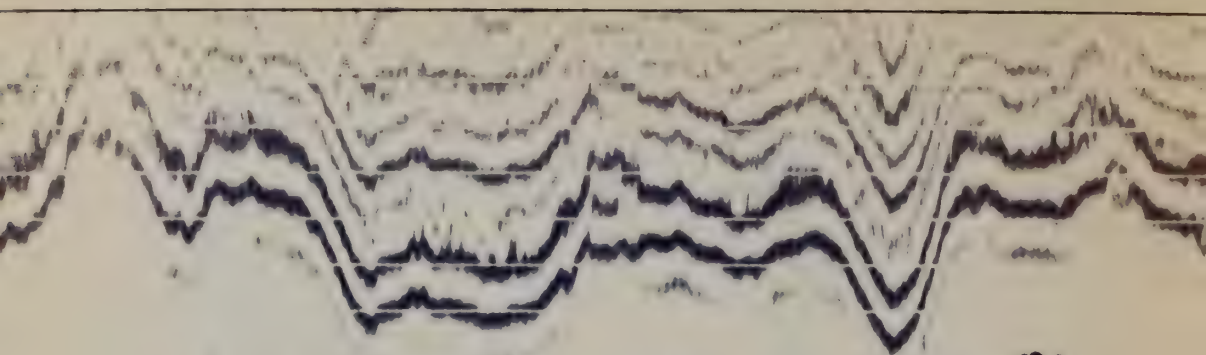




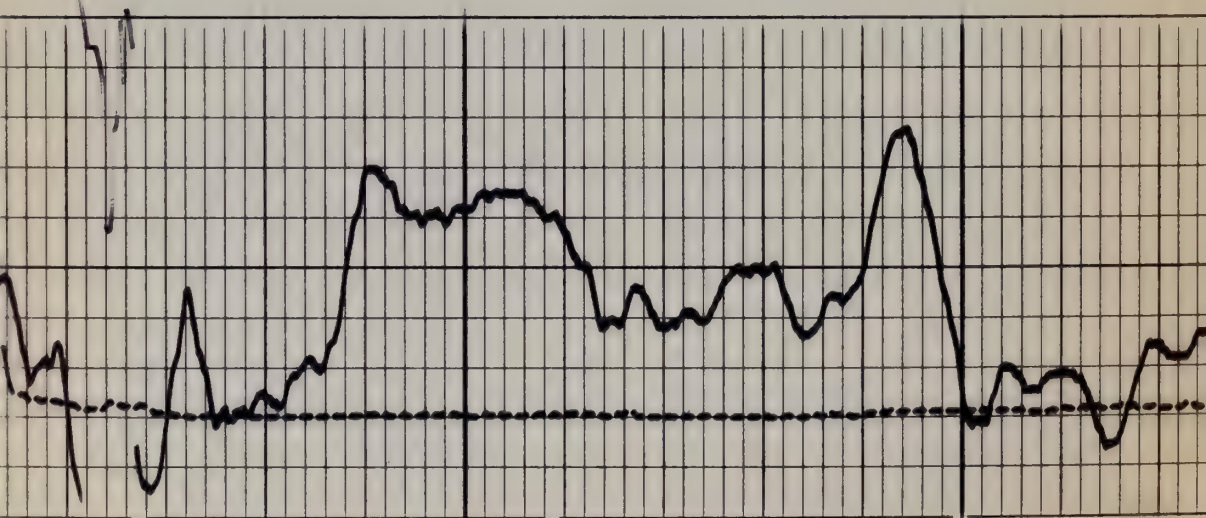


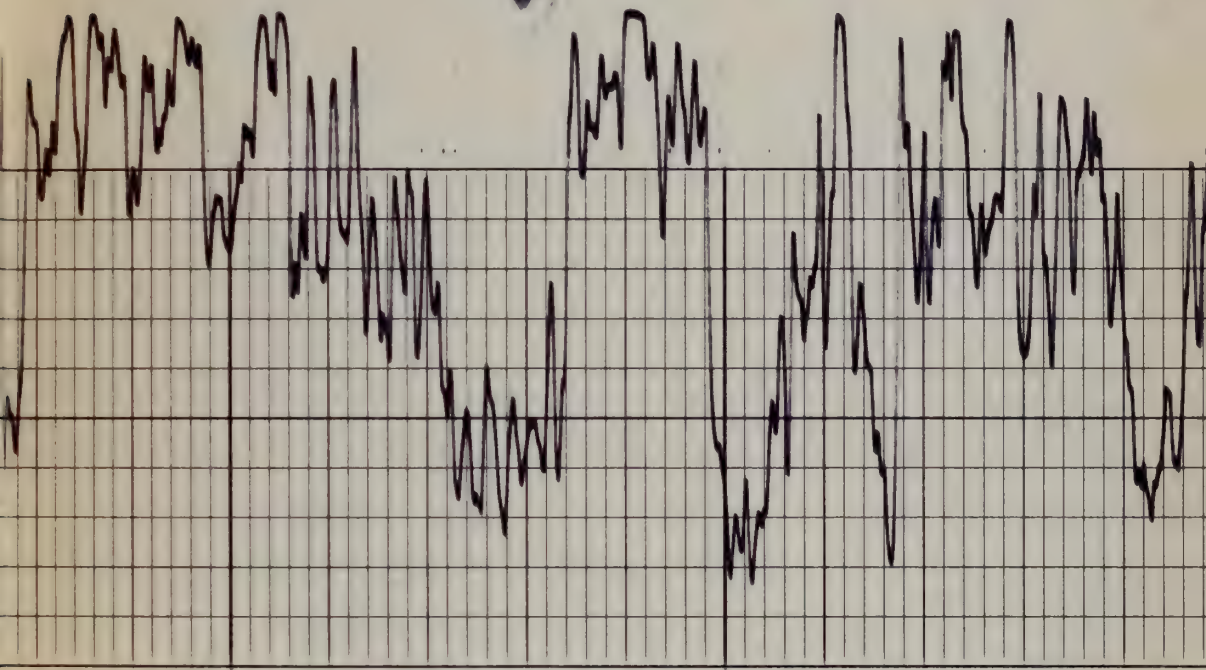
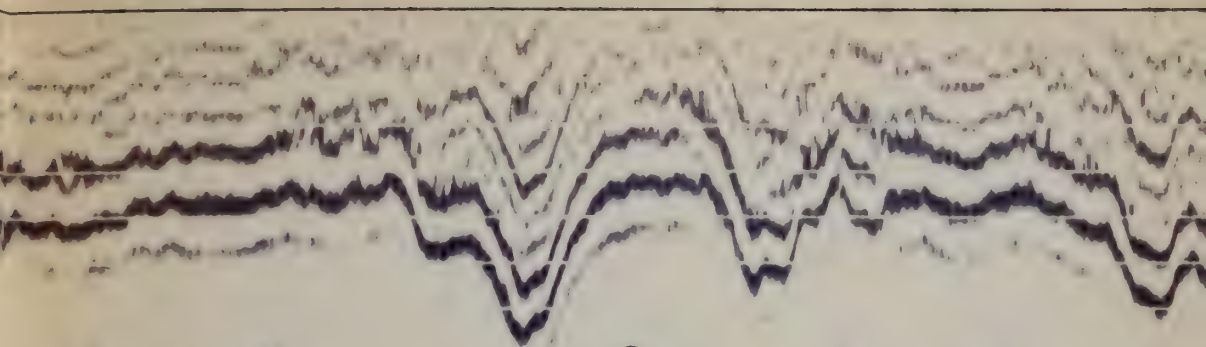
0600





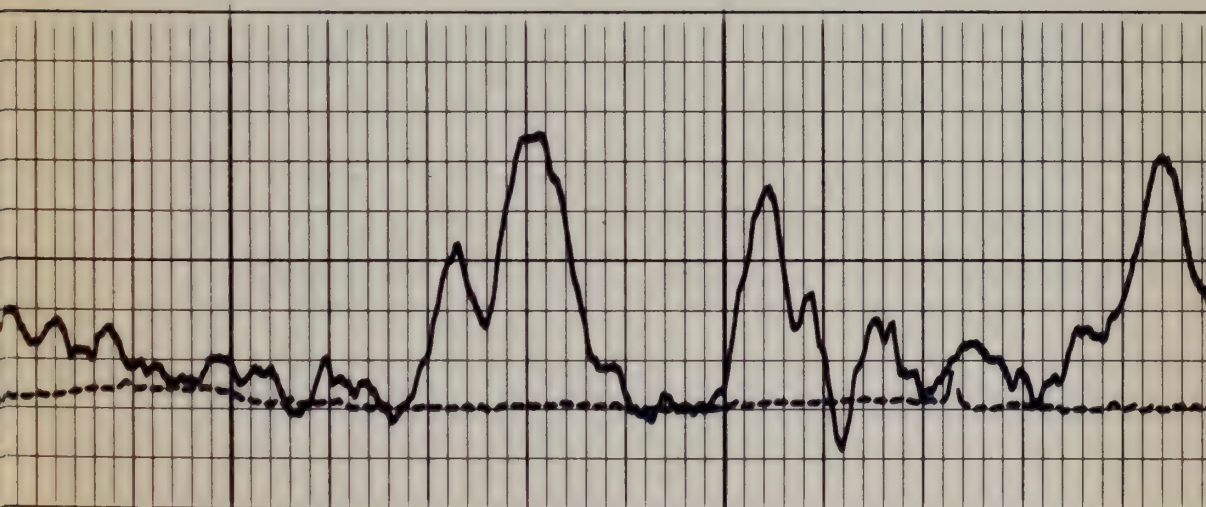
0700

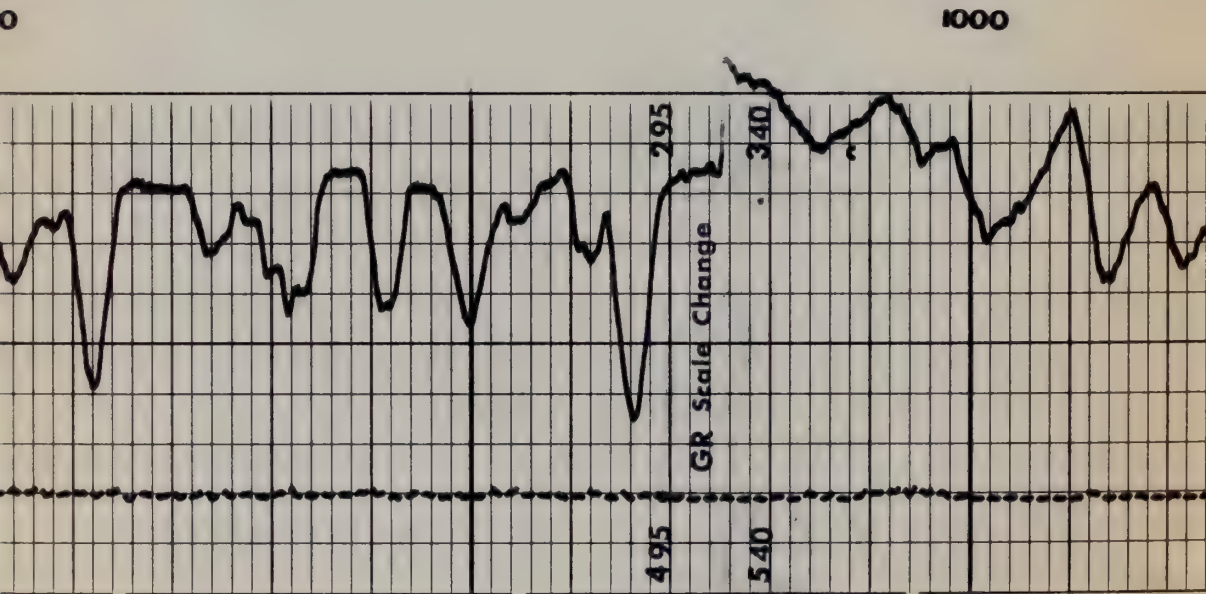
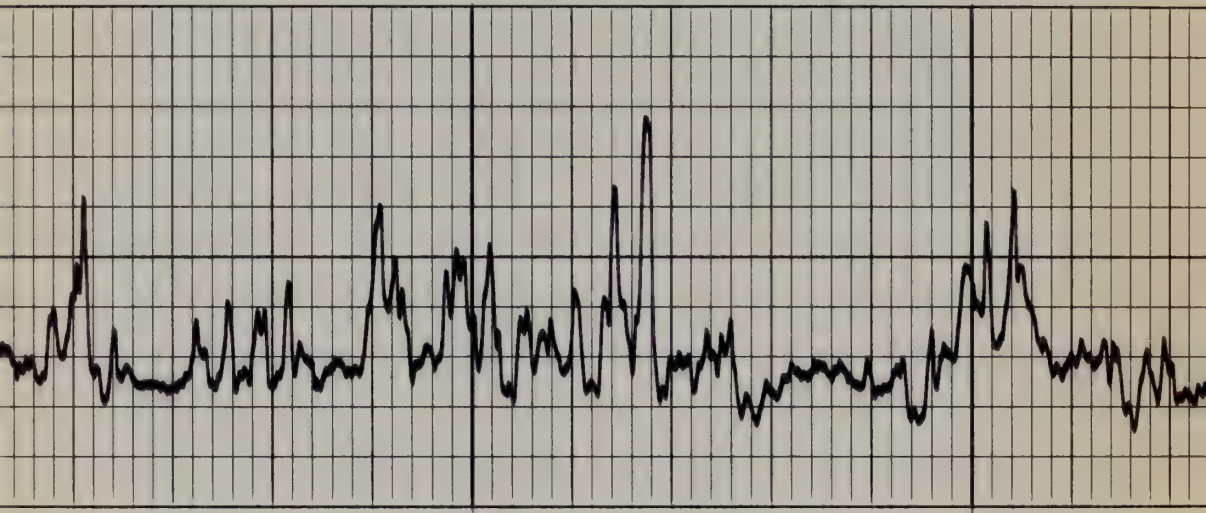
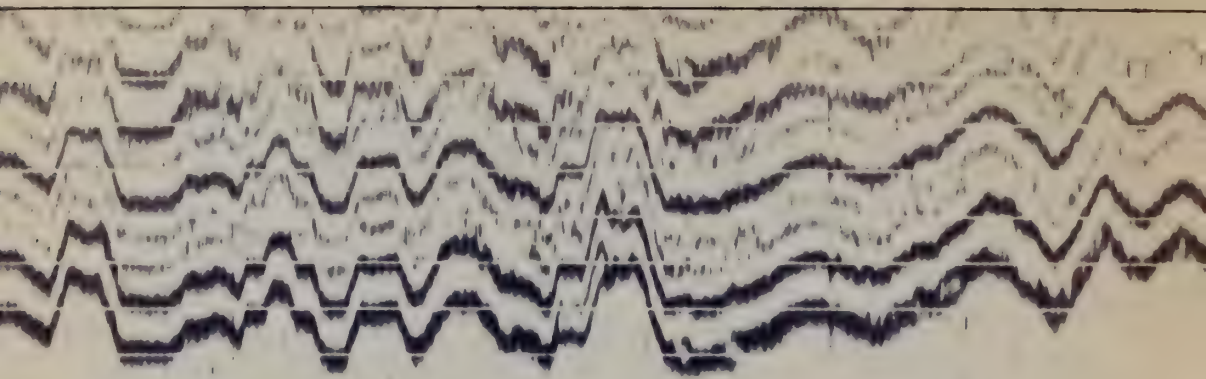


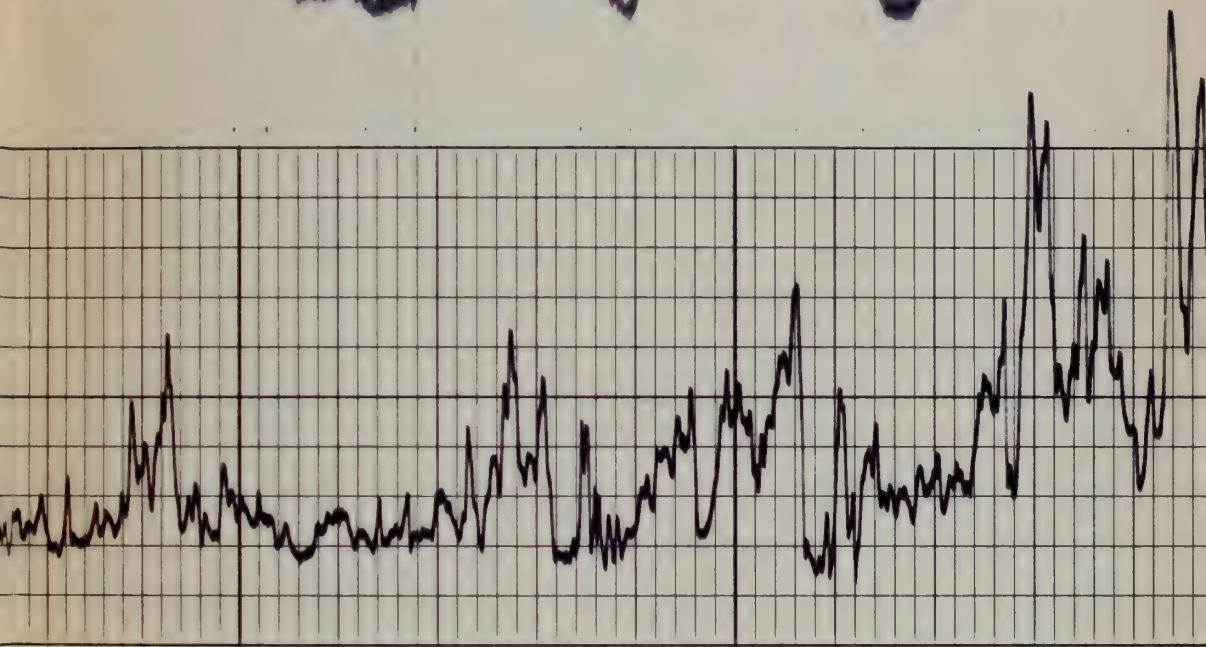
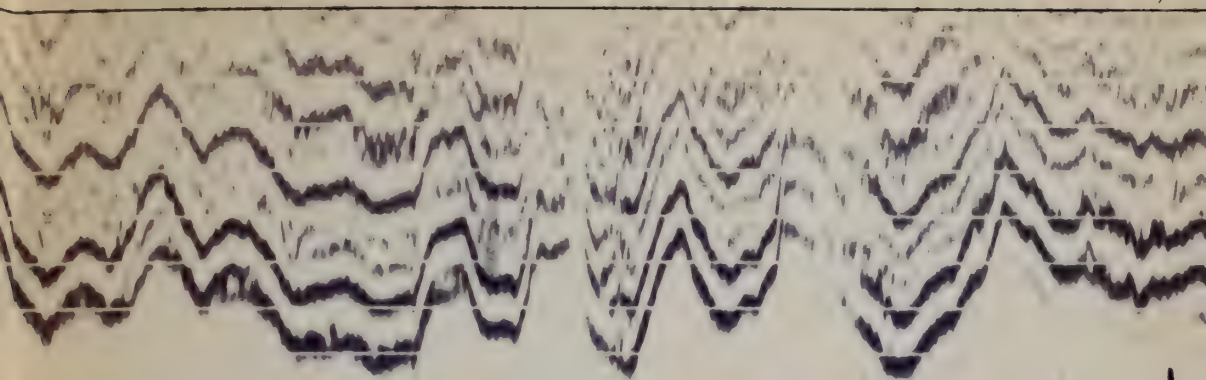


0800

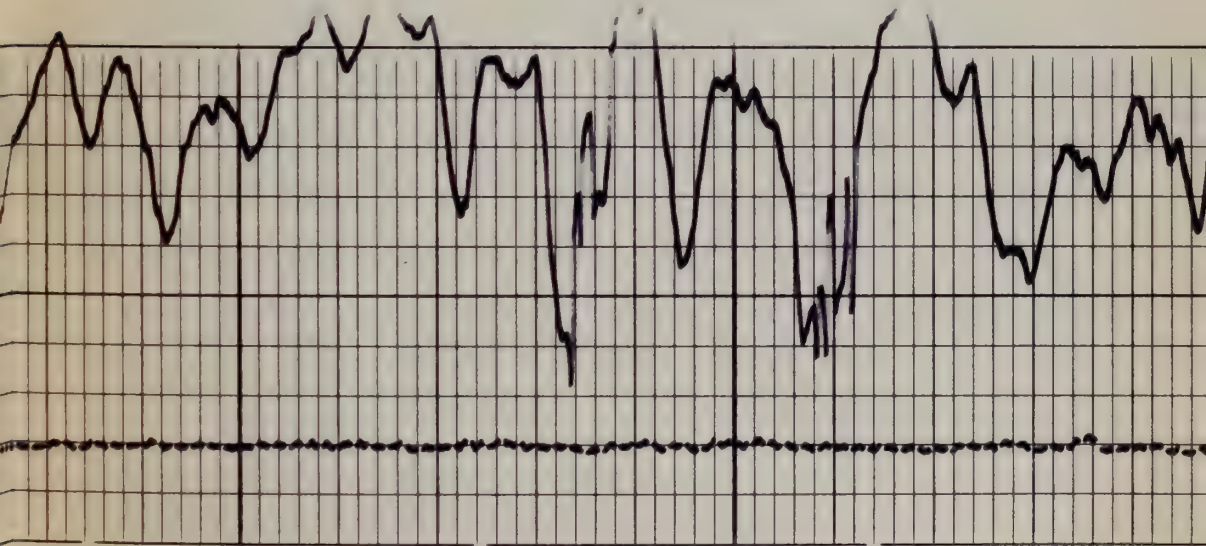
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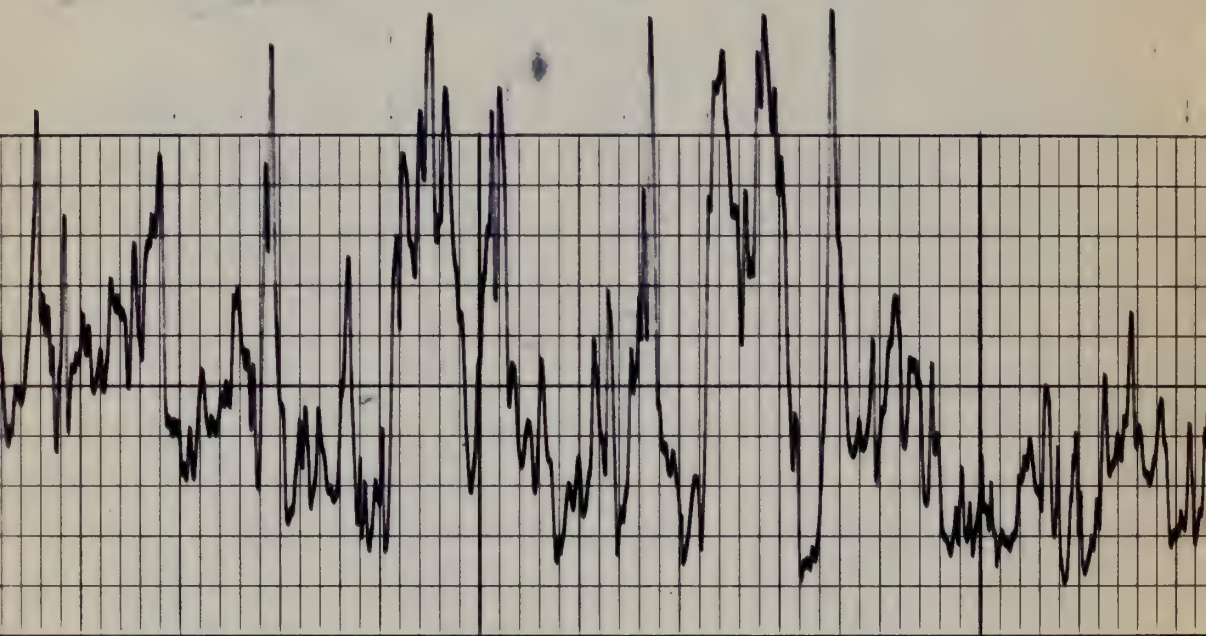
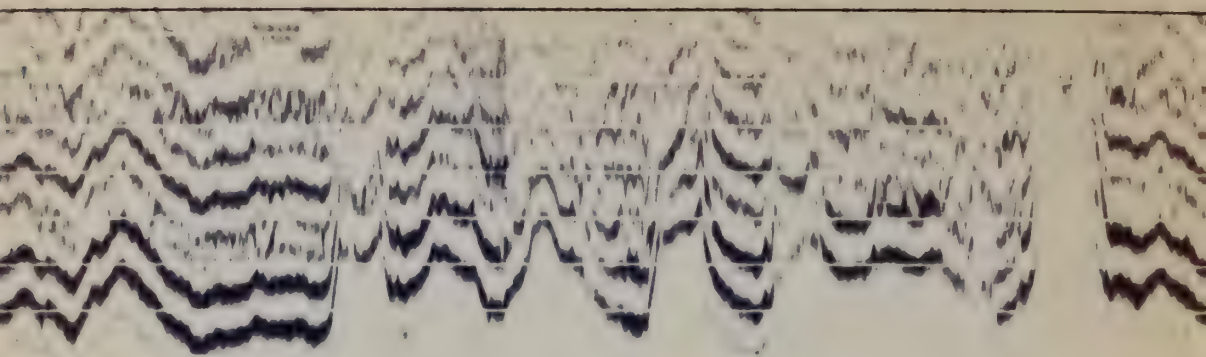




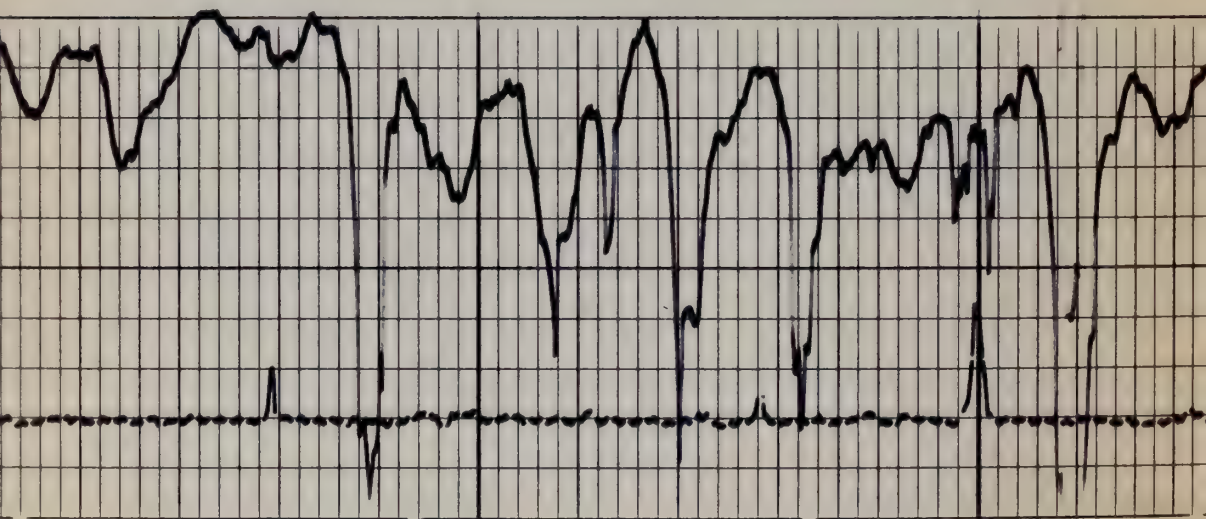


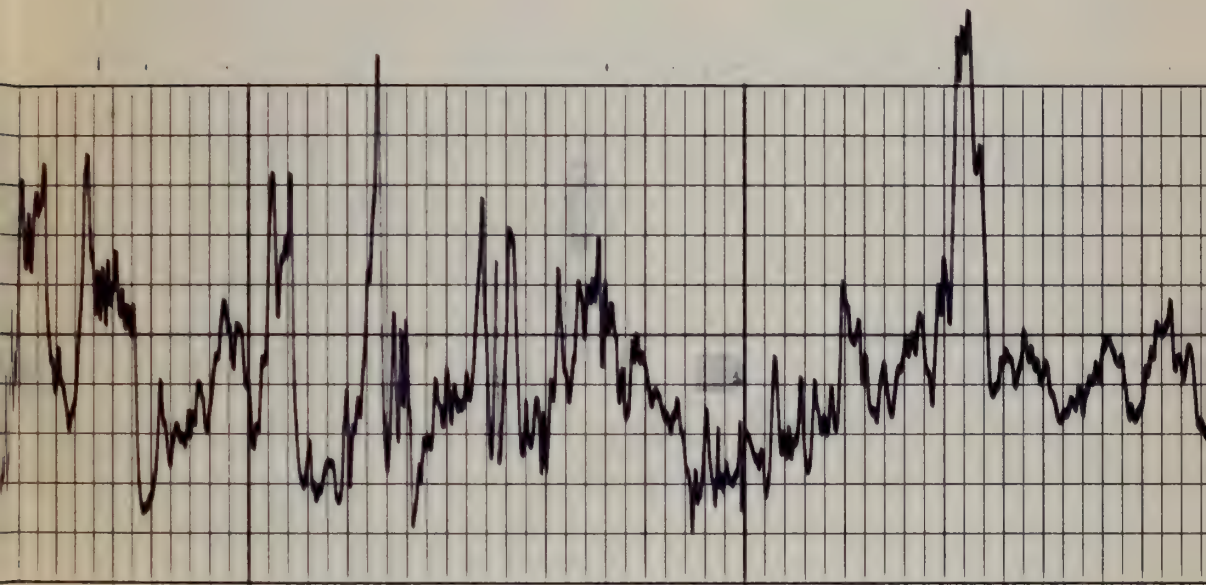
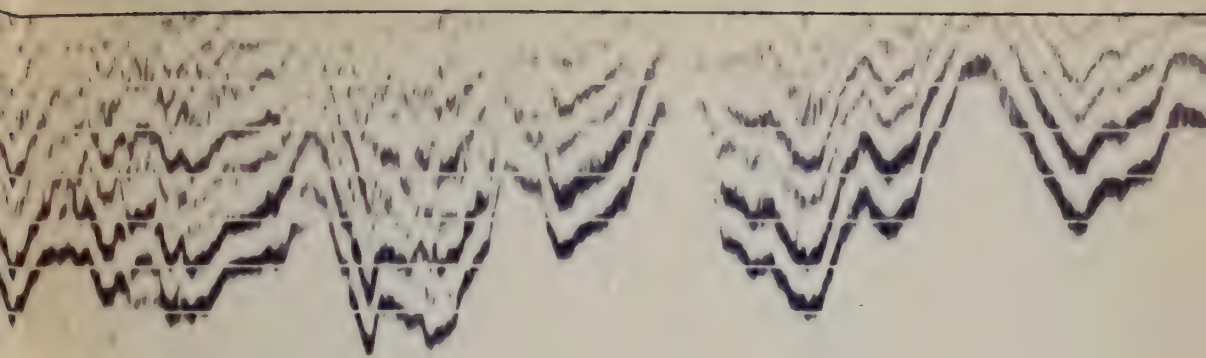
1100



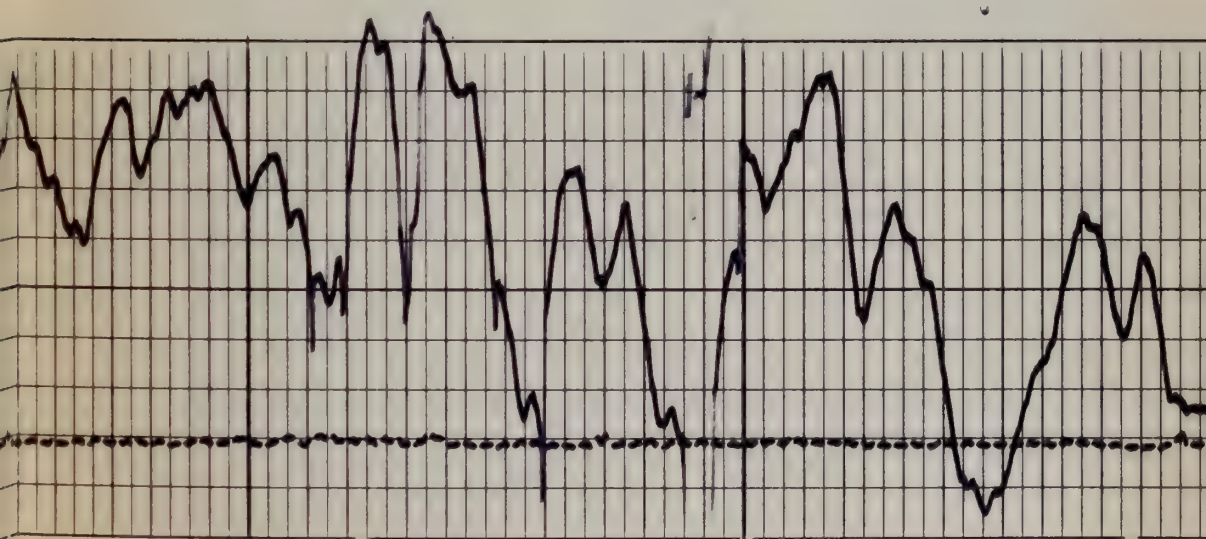


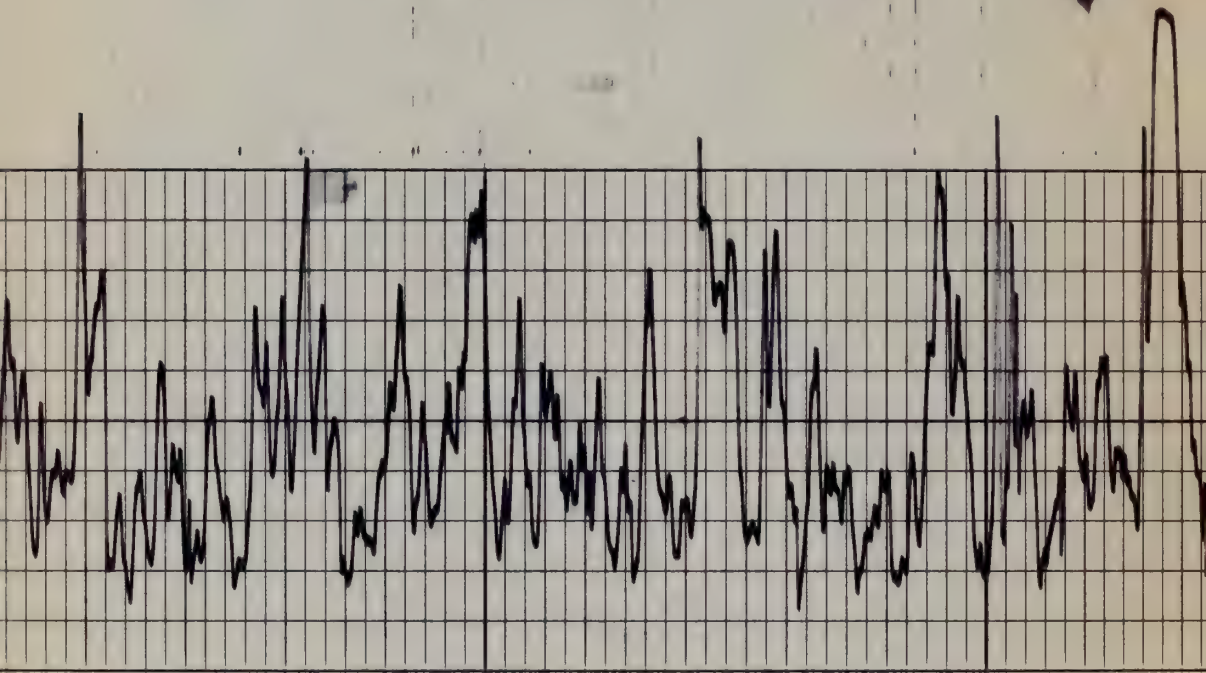
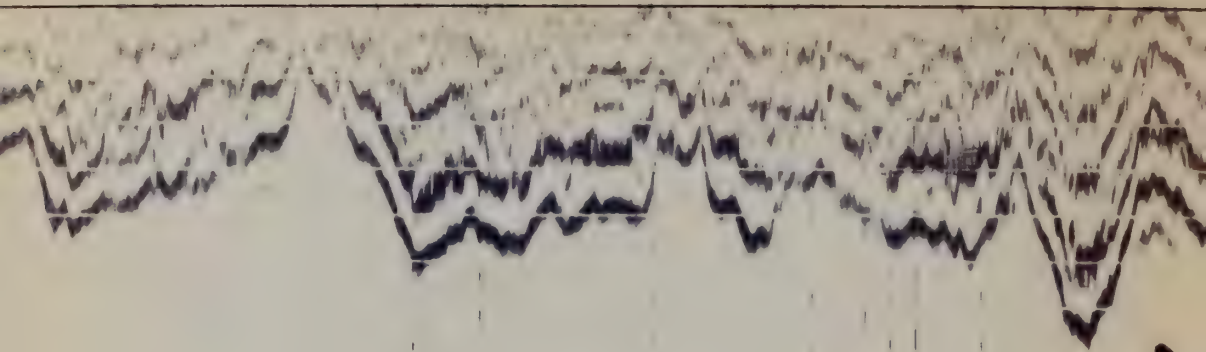
1200





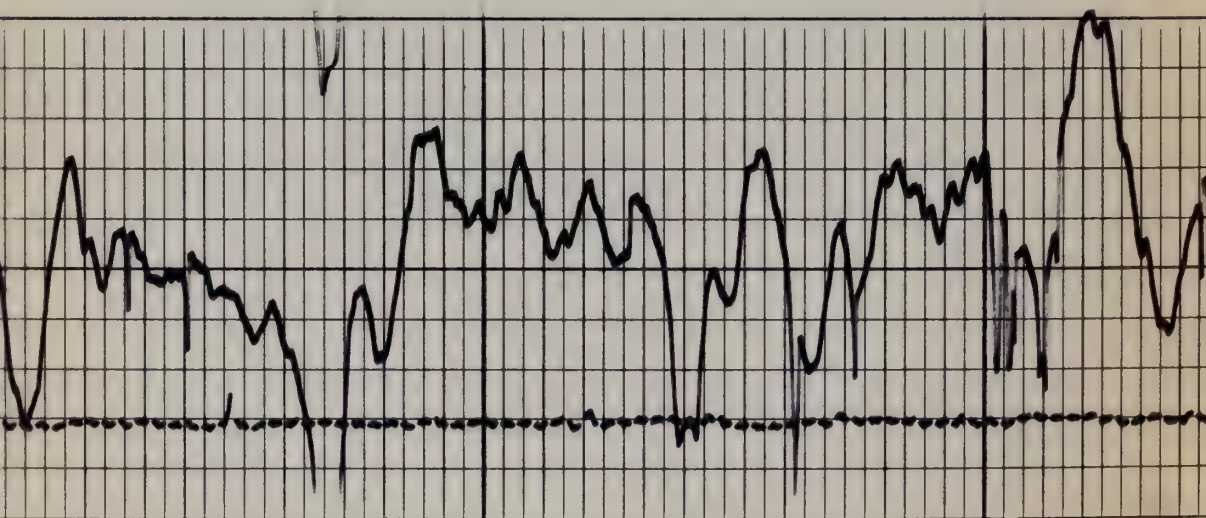
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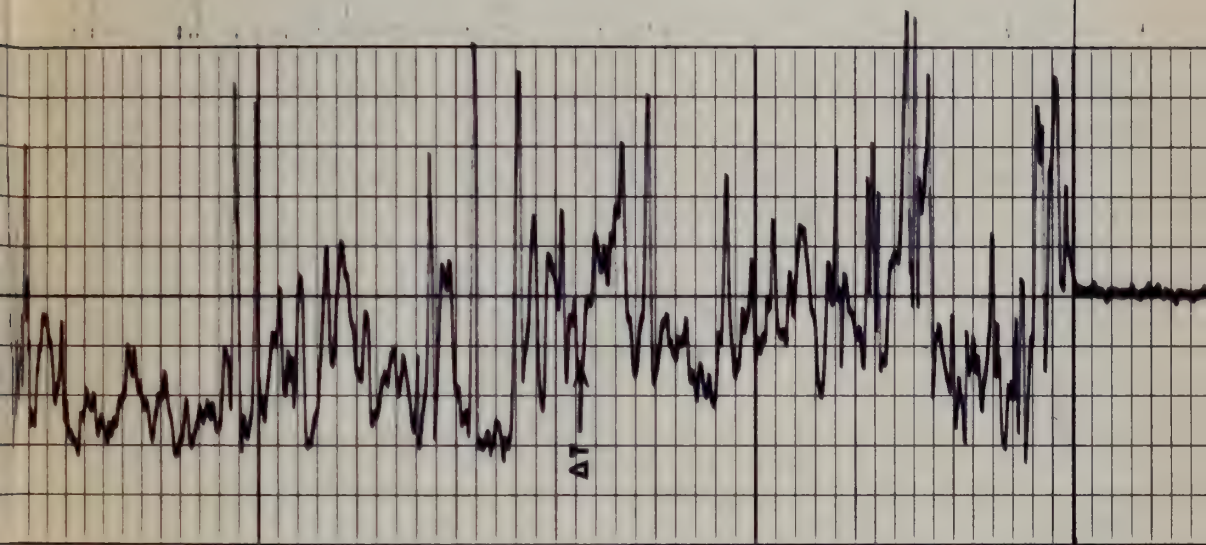
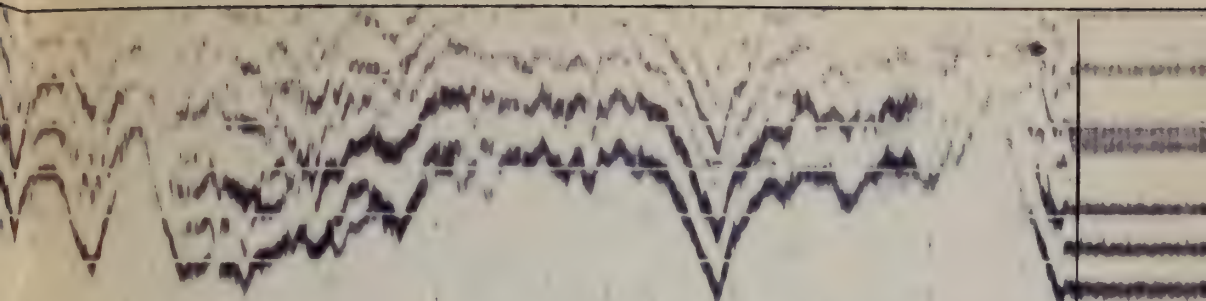




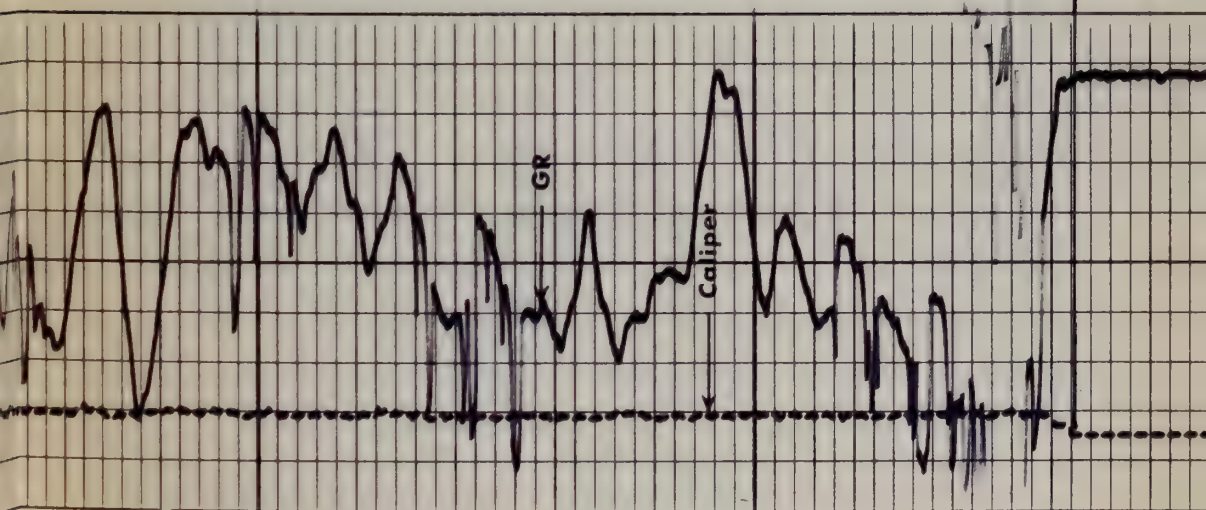
0

1500





1600



6 --- CALIPER --- 16
540 340

SINGLE AT RECEIVER
TIME
MICROSECONDS

AMPLITUDE MILLIVOLTS

0 20

VARIABLE DENSITY
MICROSECONDS

200 1200

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640
SCHL. TD 1642
DRLR TD 1638
Elev: KB -----
DF -----
GL 6909

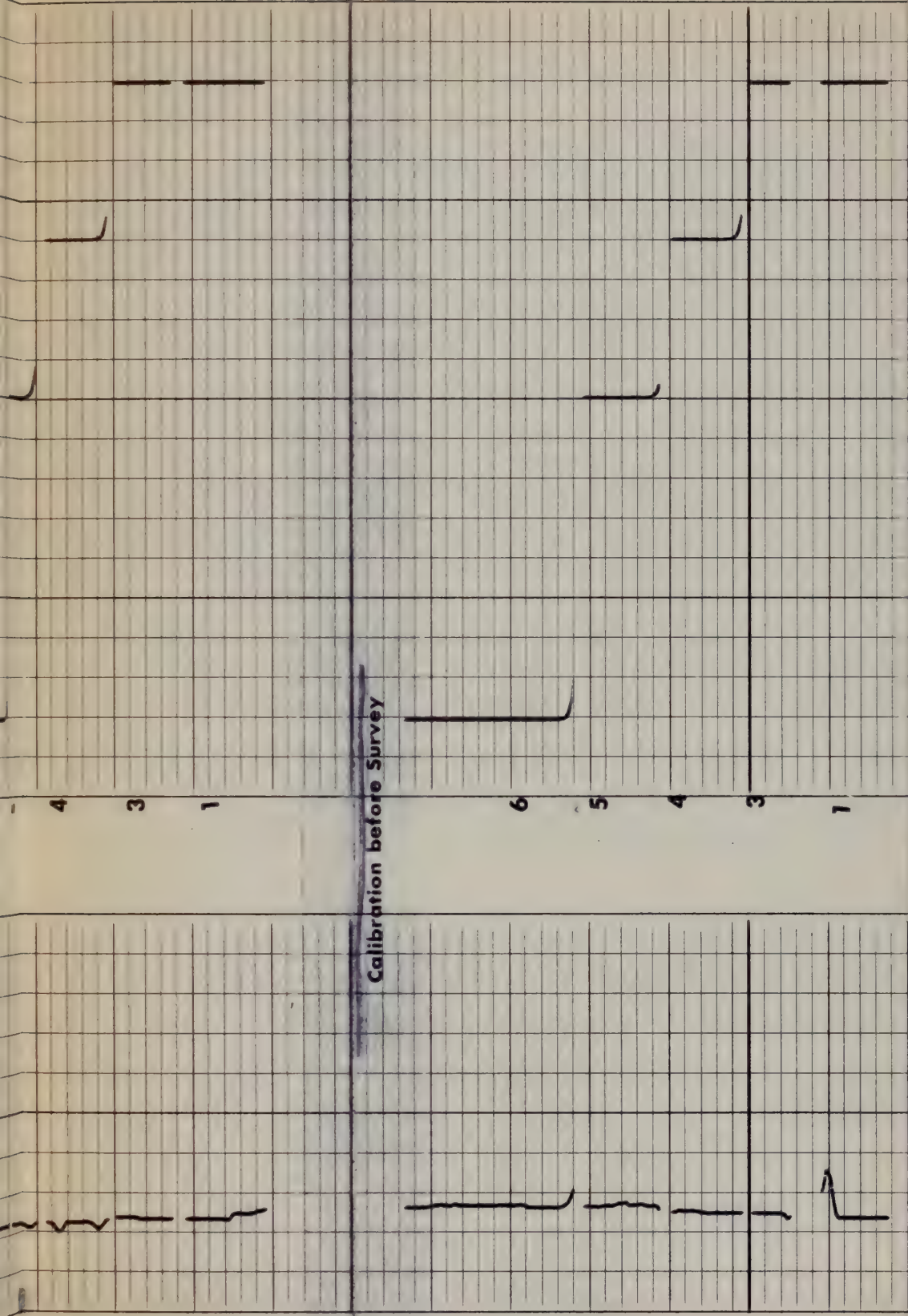
CALIBRATION DATA



Calibration after Survey

6

5



3. 60 μ SEC/FT
4. 80 μ SEC/FT
5. 100 μ SEC/FT
6. 140 μ SEC/FT

GAMMA RAY CALIBRATION CODING

1. MECHANICAL ZERO
2. ELECTRICAL ZERO
3. RECORDER SENSITIVITY
4. MEMORIZER ADJUSTMENT
5. BACKGROUND
6. CALIBRATION



CALIBRATION DATA

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640

SCHL. TD 1642

DRLR TD 1638

Elev:

KB ----

DF ----

GL 6909

Schlumberger

COMPENSATED NEUTRON-
FORMATION DENSITY

COUNTY RIO BLANCO
 FIELD or LOCATION ---
 WELL AQUIFER TEST
 NO. NO. 1-B
 COMPANY ATLANTIC RICHFIELD

COMPANY THE ATLANTIC RICHFIELD COMPANYWELL AQUIFER TEST NO.1-BFIELD ----COUNTY RIO BLANCO STATE COLORADOLocation: API Serial No. 01036Sec. 7 Twp. 3S Rge. 96W

Other Services:

DIL ENG.PRO
 FDC-GR
 BHC-GR

Permanent Datum: GL; Elev.: 6909
 Log Measured From GL, 0 Ft. Above Perm. Datum
 Drilling Measured From GL

Elev.: K.B. ----
 D.F. ----
 G.L. 6909

Date	7-21-74					
Run No.	ONE					
Depth-Driller	1638					
Depth-Logger	1641					
Btm. Log Interval	1640					
Top Log Interval	72					
Casing-Driller	8-5/8@ 60			@	@	@
Casing-Logger	72					
Bit Size	7-7/8					
Type Fluid in Hole	WATER					
Fluid Level	410					
Dens.	Visc.	8.3				
pH	Fluid Los	----	-- ml		ml	ml
Source of Sample						
R _{mm} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mf} @ Meas. Temp.	@	°F	@	°F	@	°F
R _{mc} @ Meas. Temp.	@	°F	@	°F	@	°F
Source: R _{mf}	R _{mc}					
R _m @ BHT	@	°F	@	°F	@	°F
Time Since Circ.	26 HRS.					
Max. Rec. Temp.	90	°F		°F		°F
Equip.	Location	5602 G.J.				
Recorded By	SCHNORR					
Witnessed By	TAIT					

1000

[illegible]

CNP

Matrix	Auto Hole Size Corr.	Hole Size Setting (if not auto)	Porosity Scale	From	To
LIME	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		30 / TK	1640	72
	<input type="checkbox"/> Yes <input type="checkbox"/> No				
	<input type="checkbox"/> Yes <input type="checkbox"/> No				
	<input type="checkbox"/> Yes <input type="checkbox"/> No				
	<input type="checkbox"/> Yes <input type="checkbox"/> No				

FDC

				FDC			
	<input type="checkbox"/> Yes <input type="checkbox"/> No				Porosity Scale	From	To
Liquid Density		Hole Fluid		Grain Density			
1.00	<input type="checkbox"/> Yes <input type="checkbox"/> No	WATER		2.71	30/TK	1640	410
.82	<input type="checkbox"/> Yes <input type="checkbox"/> No	AIR		2.71	30/TK	410	72

Service Order No. - 50 #01036

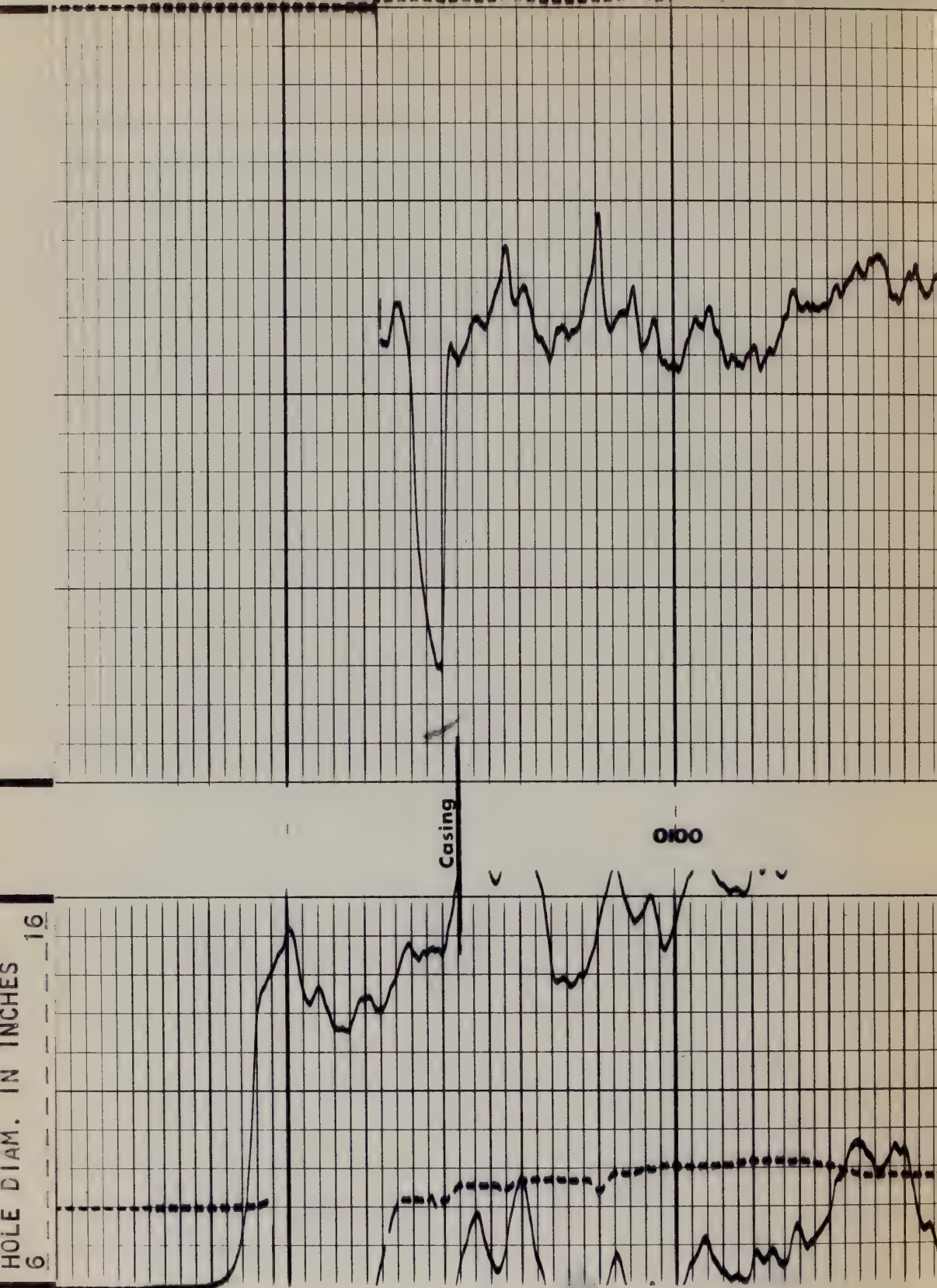
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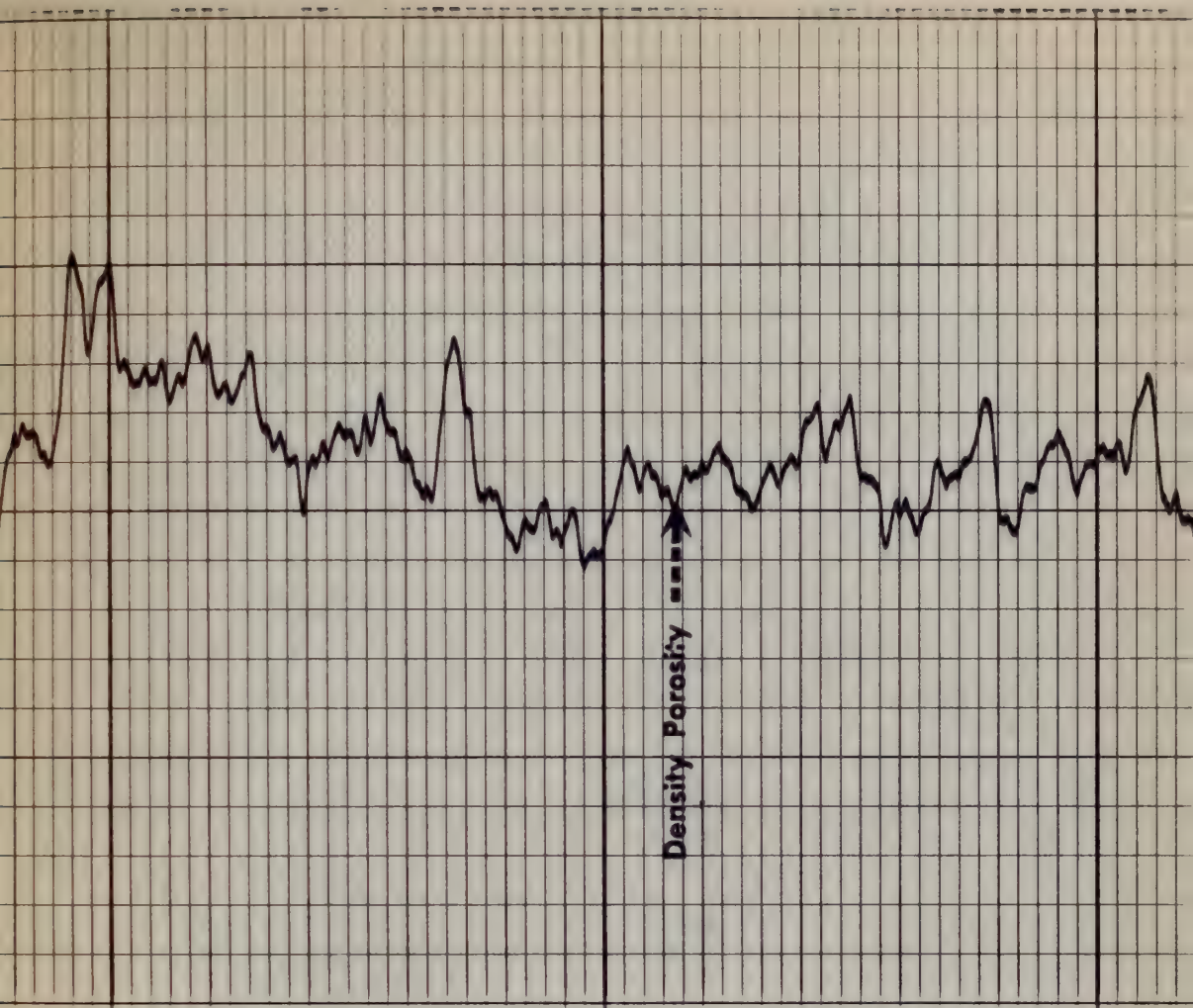
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7-	1638	60	8-5/8		60	GL

HOLE DIAM. IN INCHES
6 16

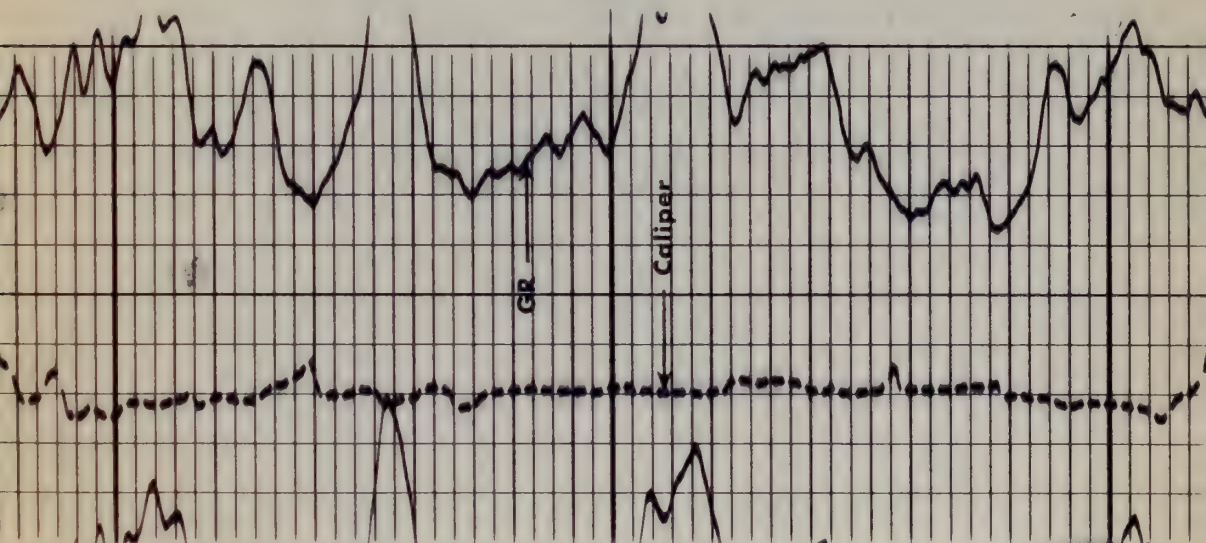
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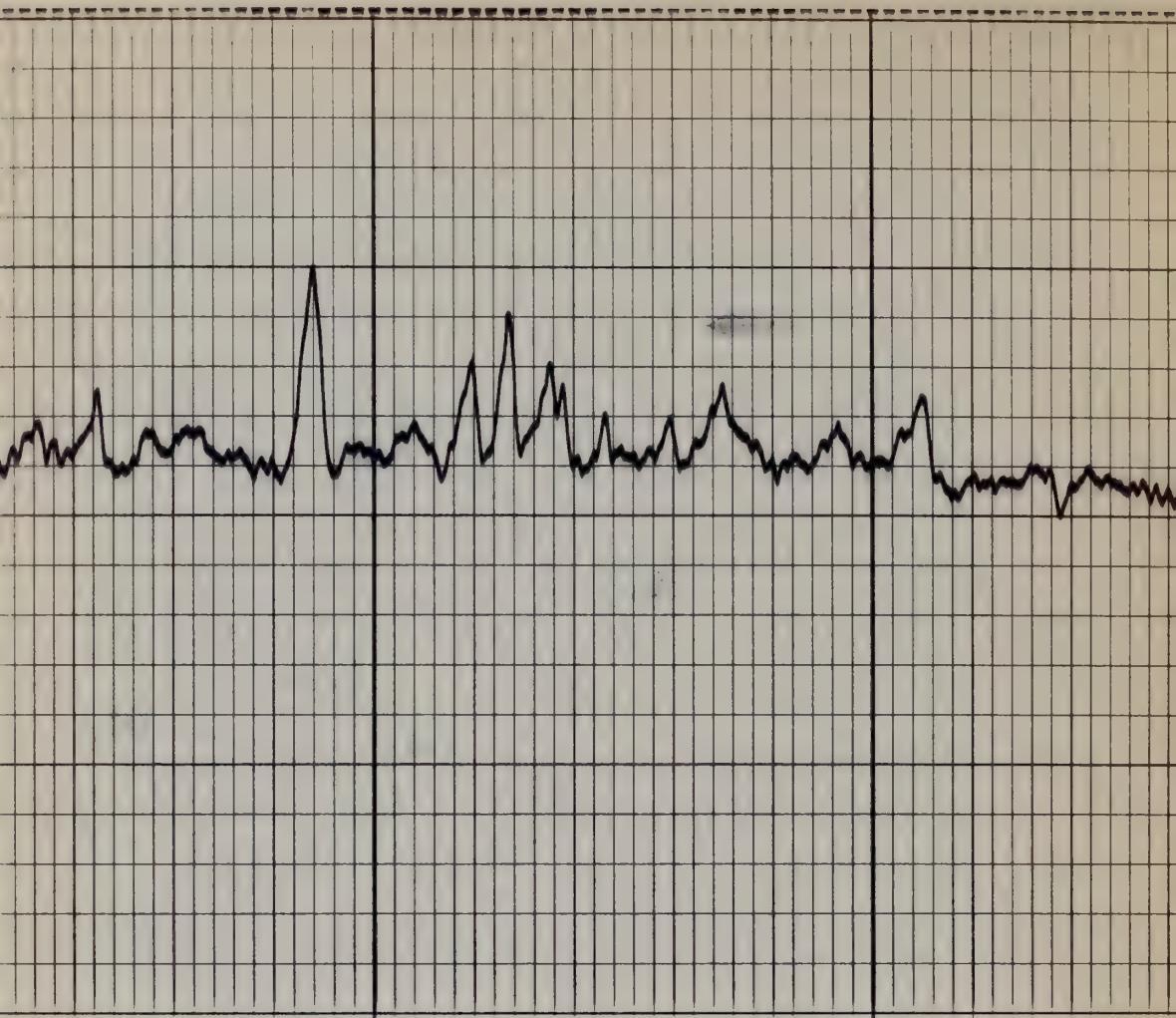
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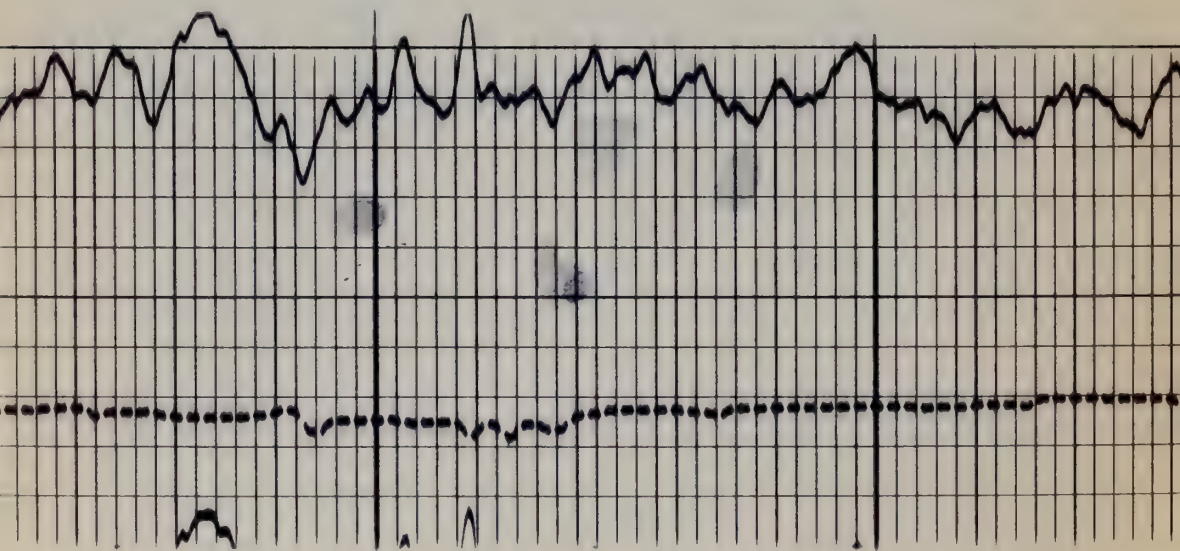


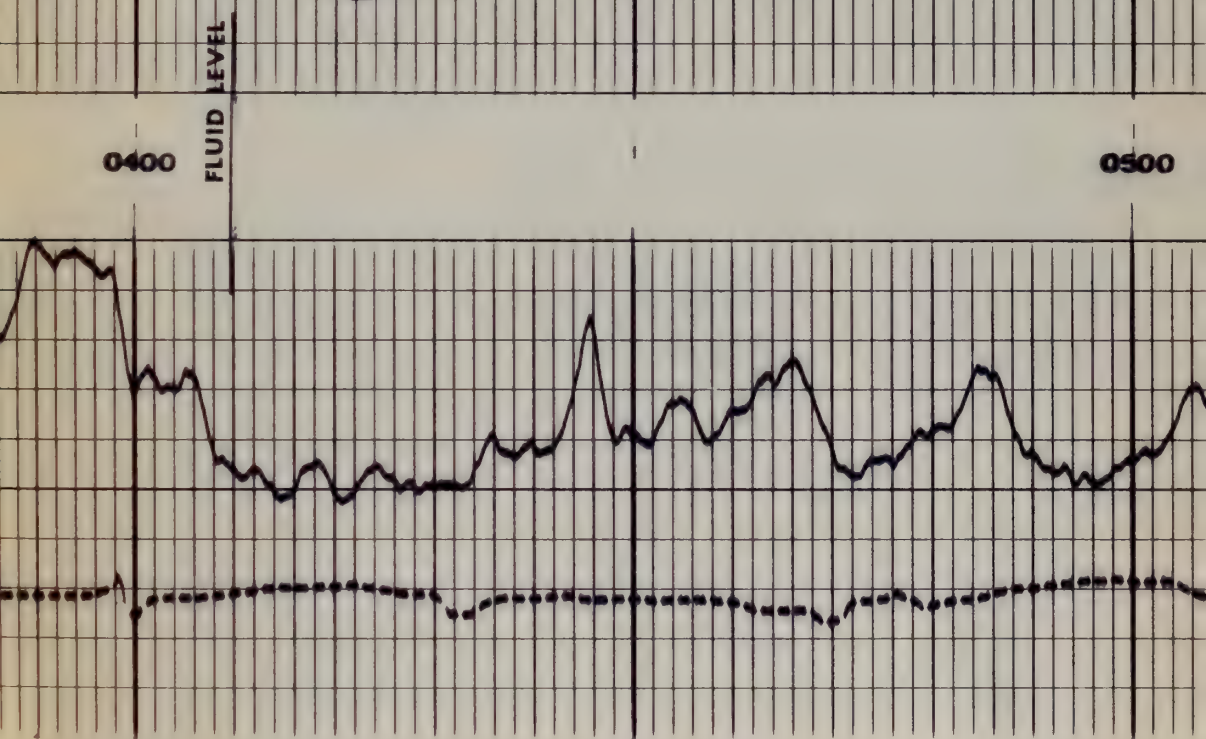
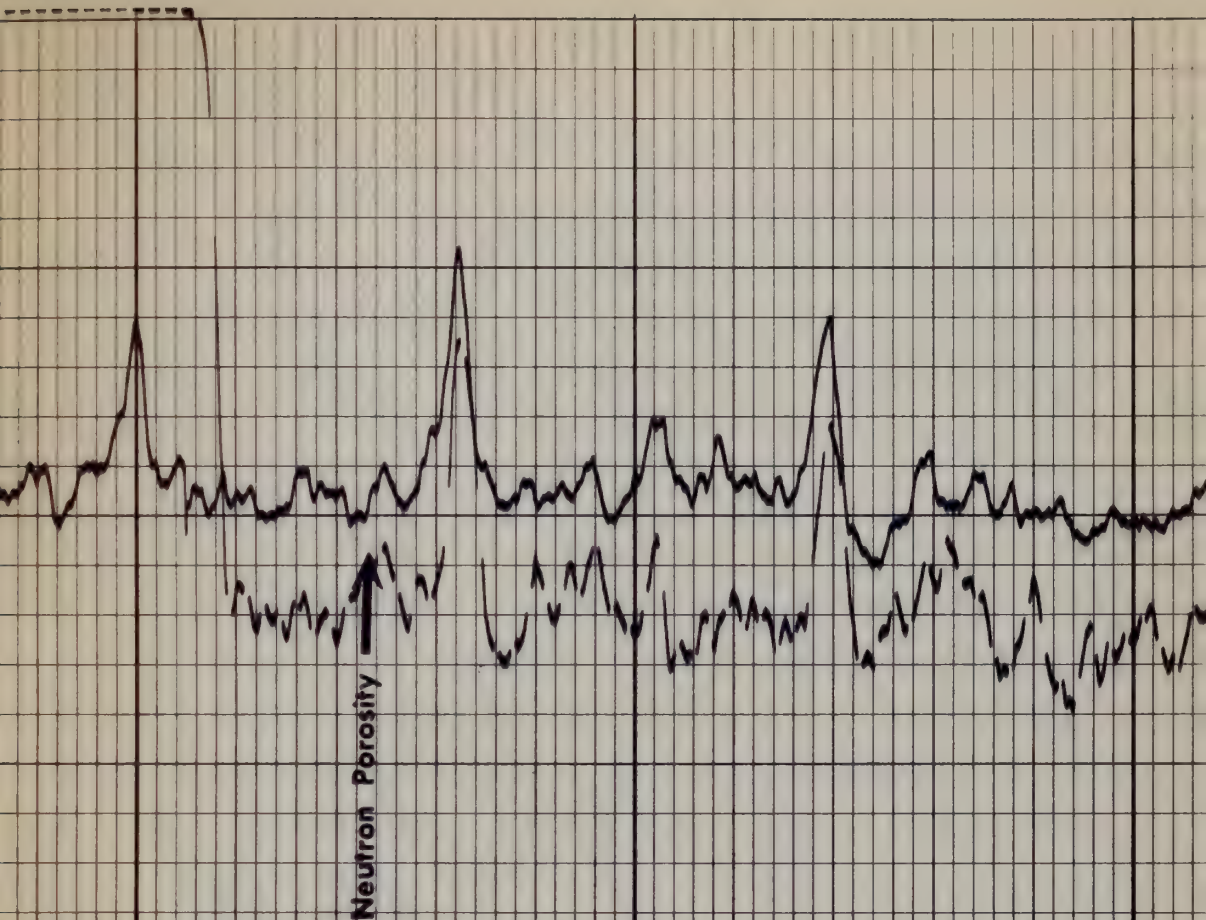
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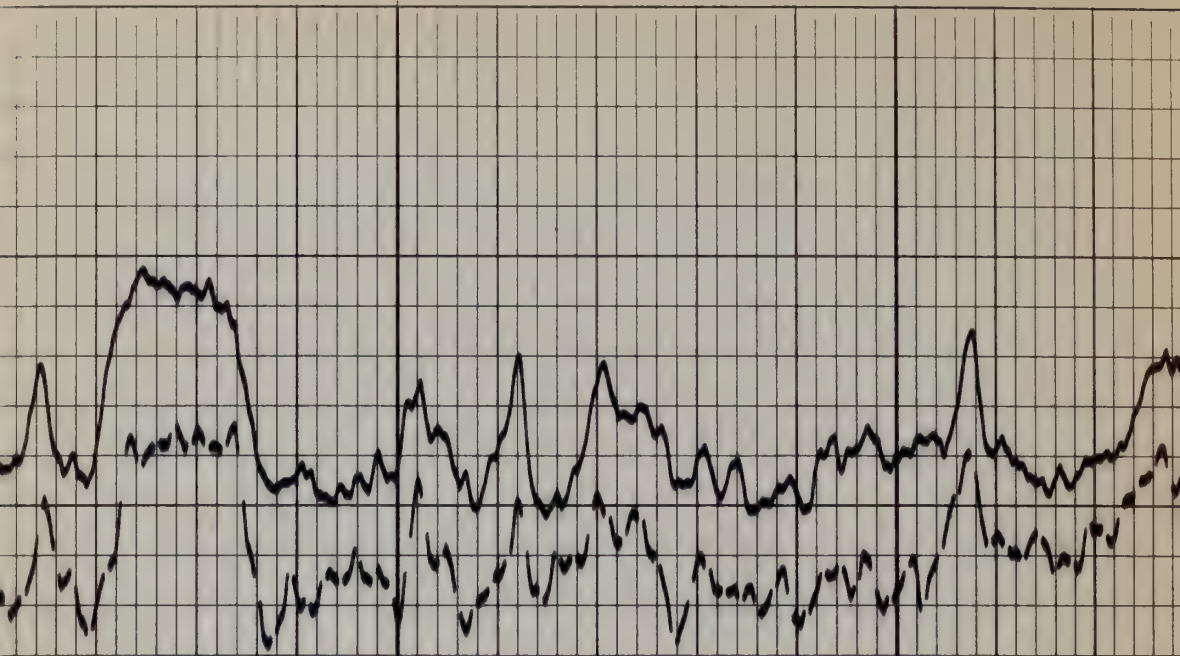




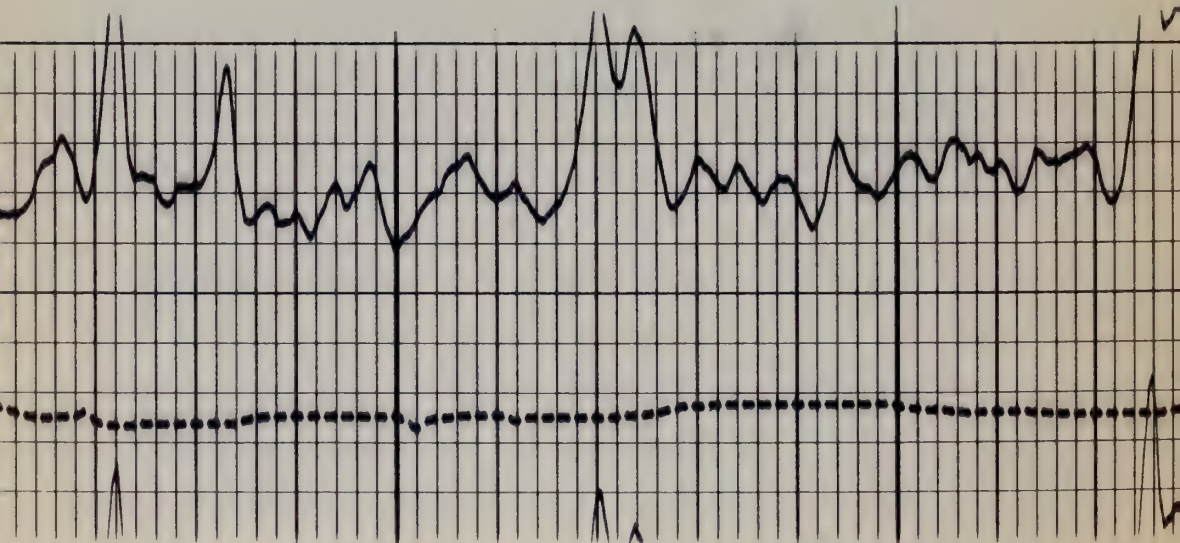
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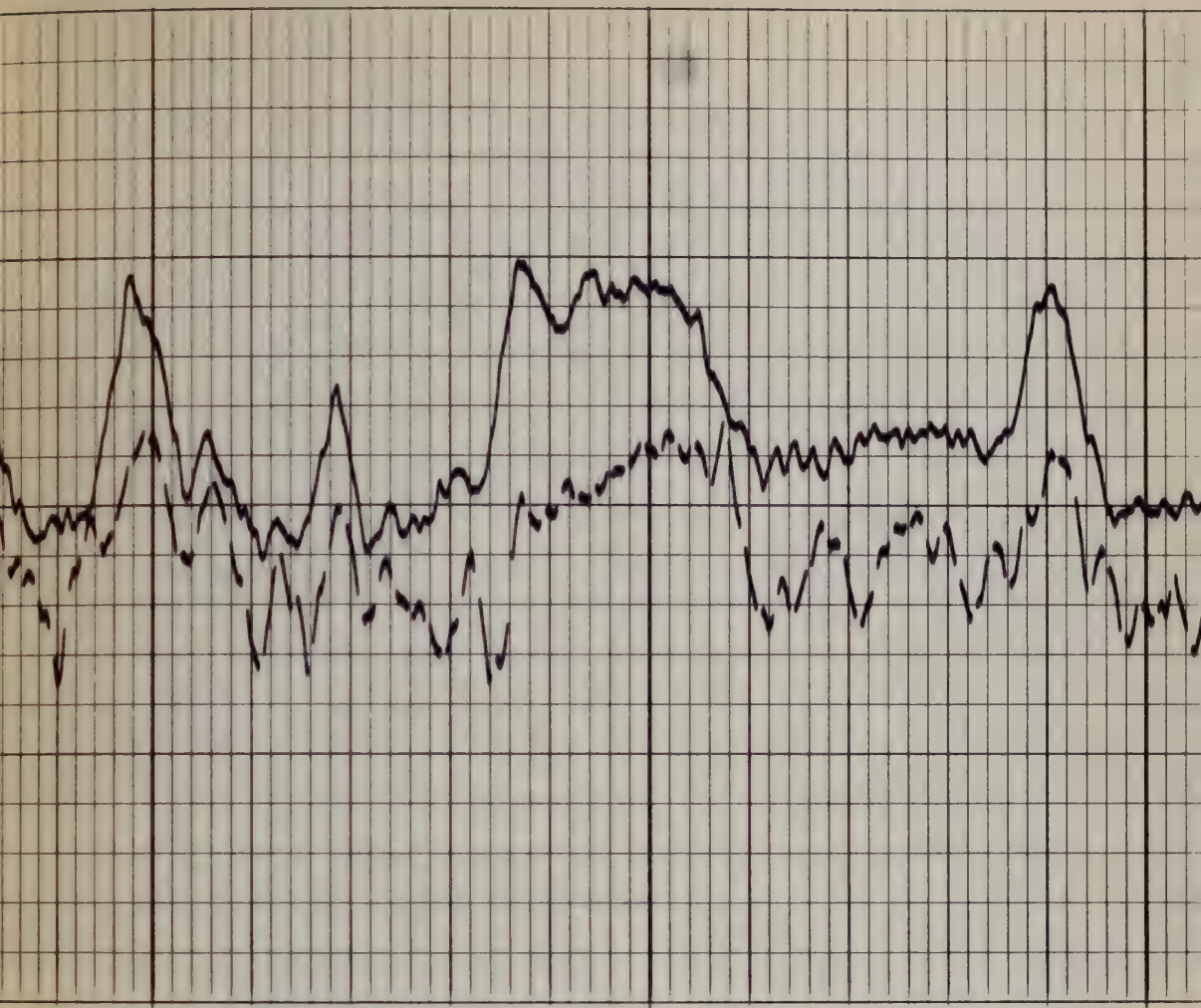




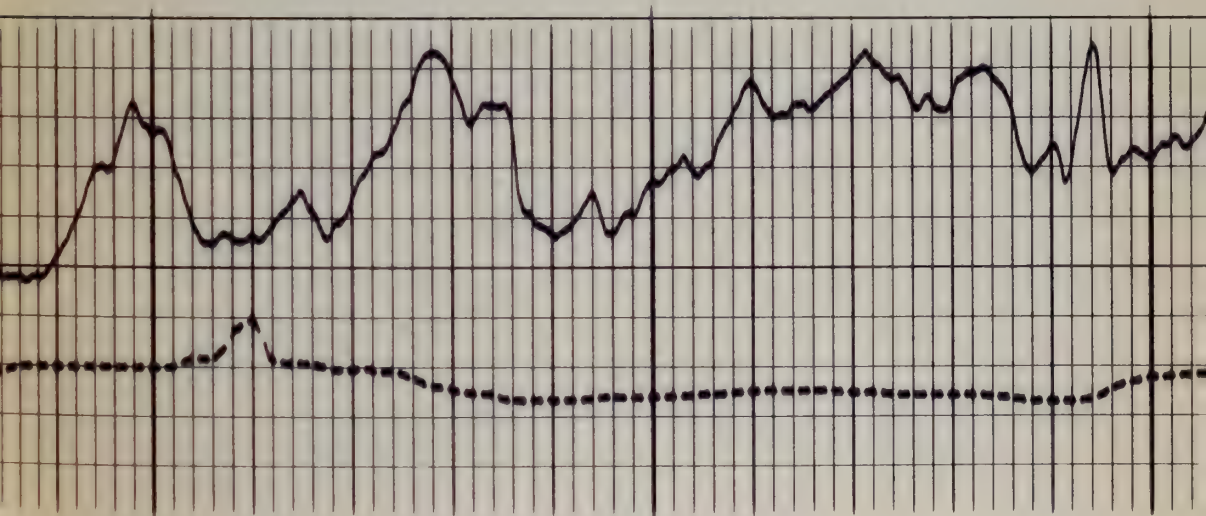


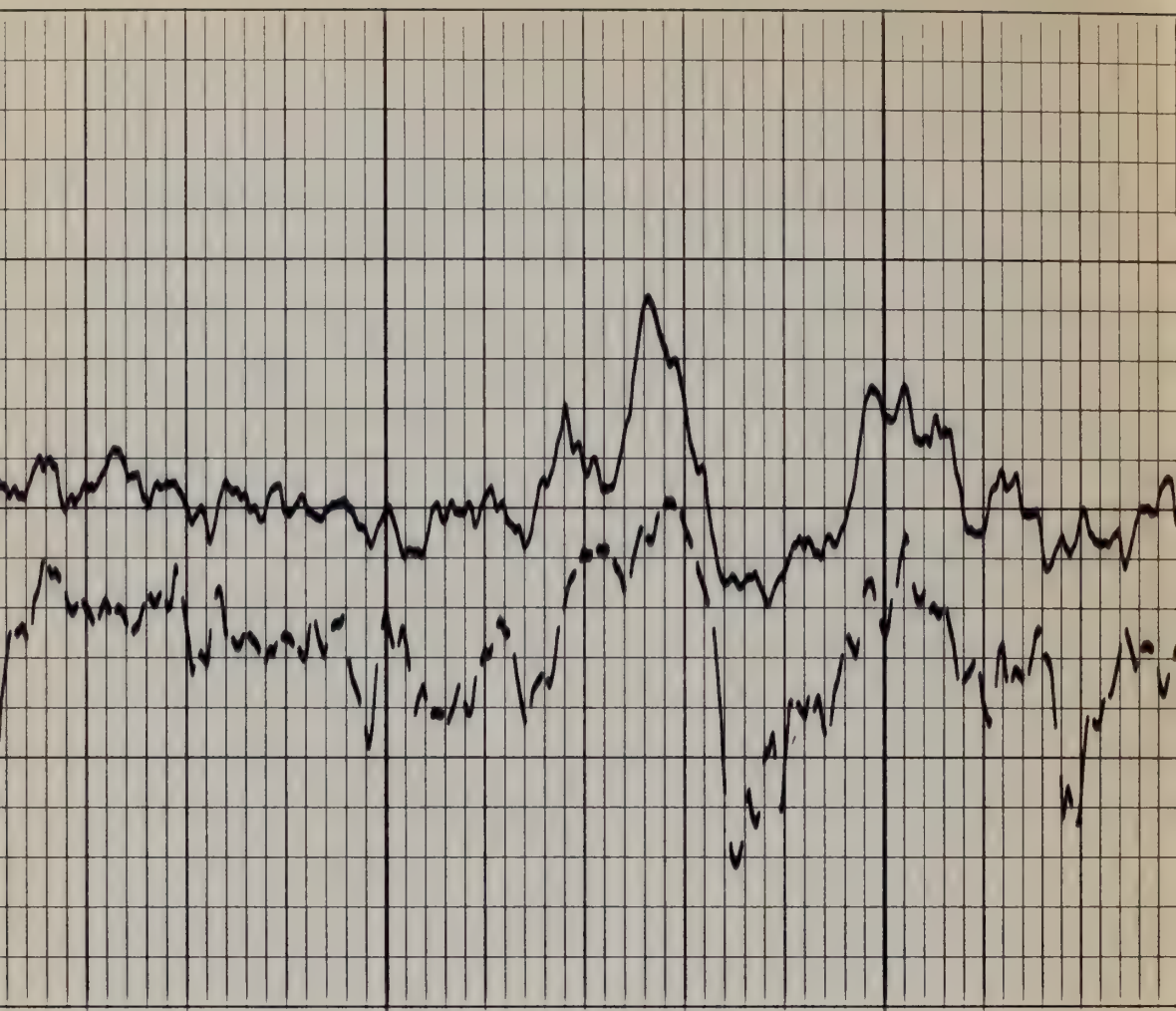
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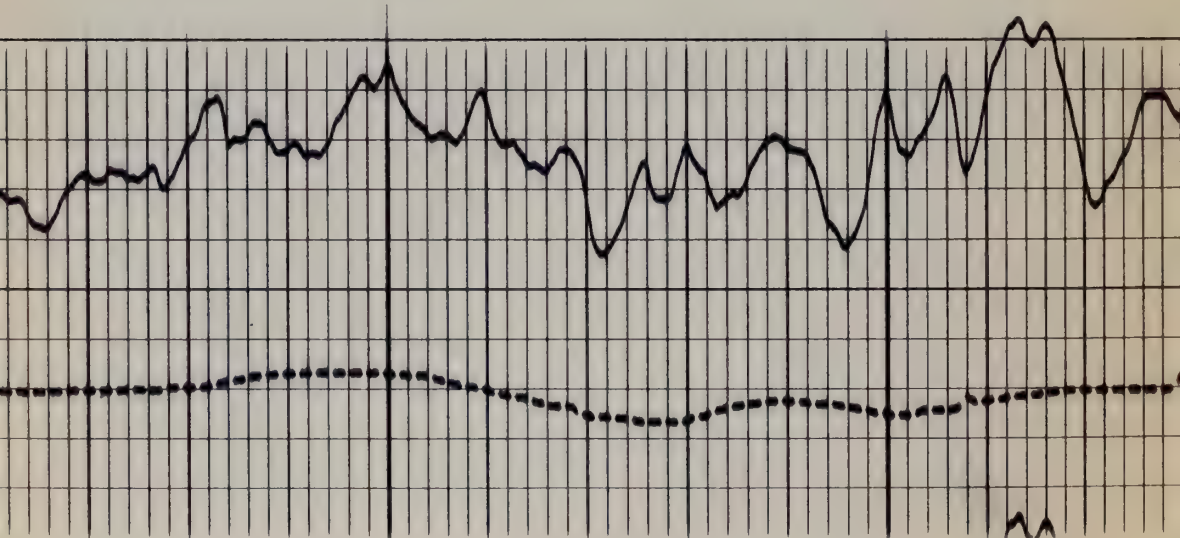


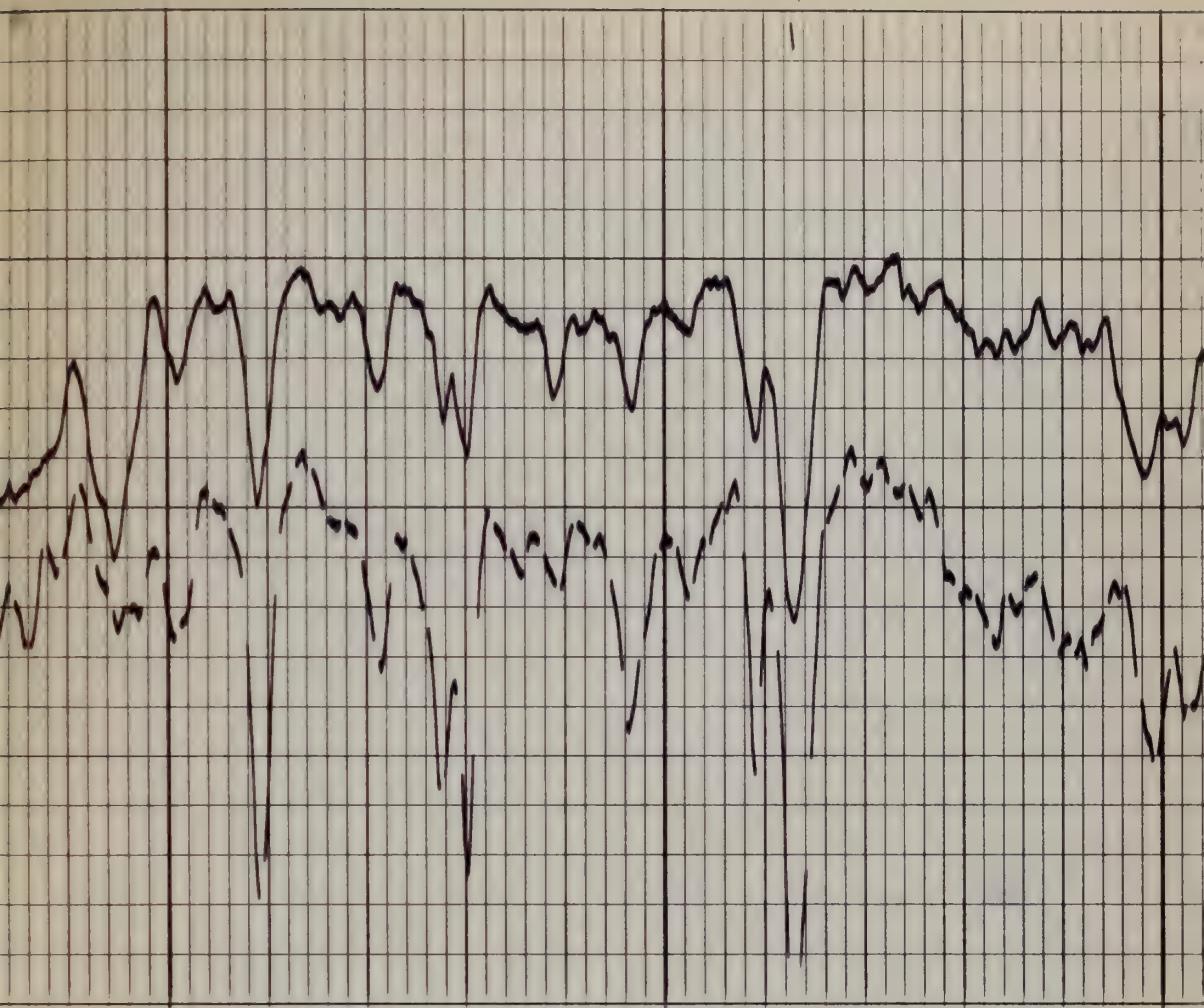
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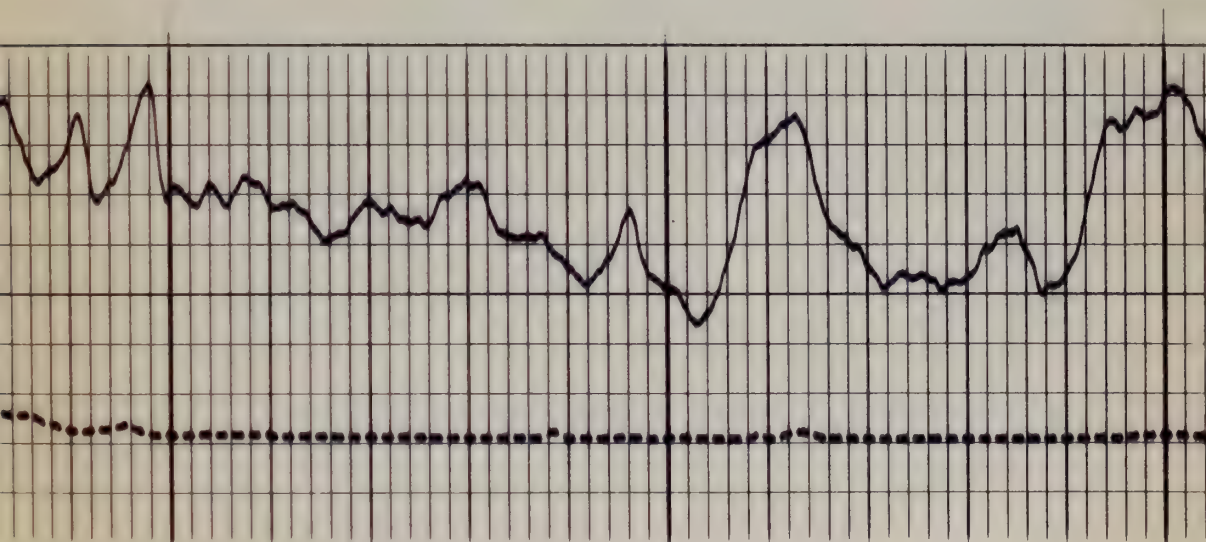
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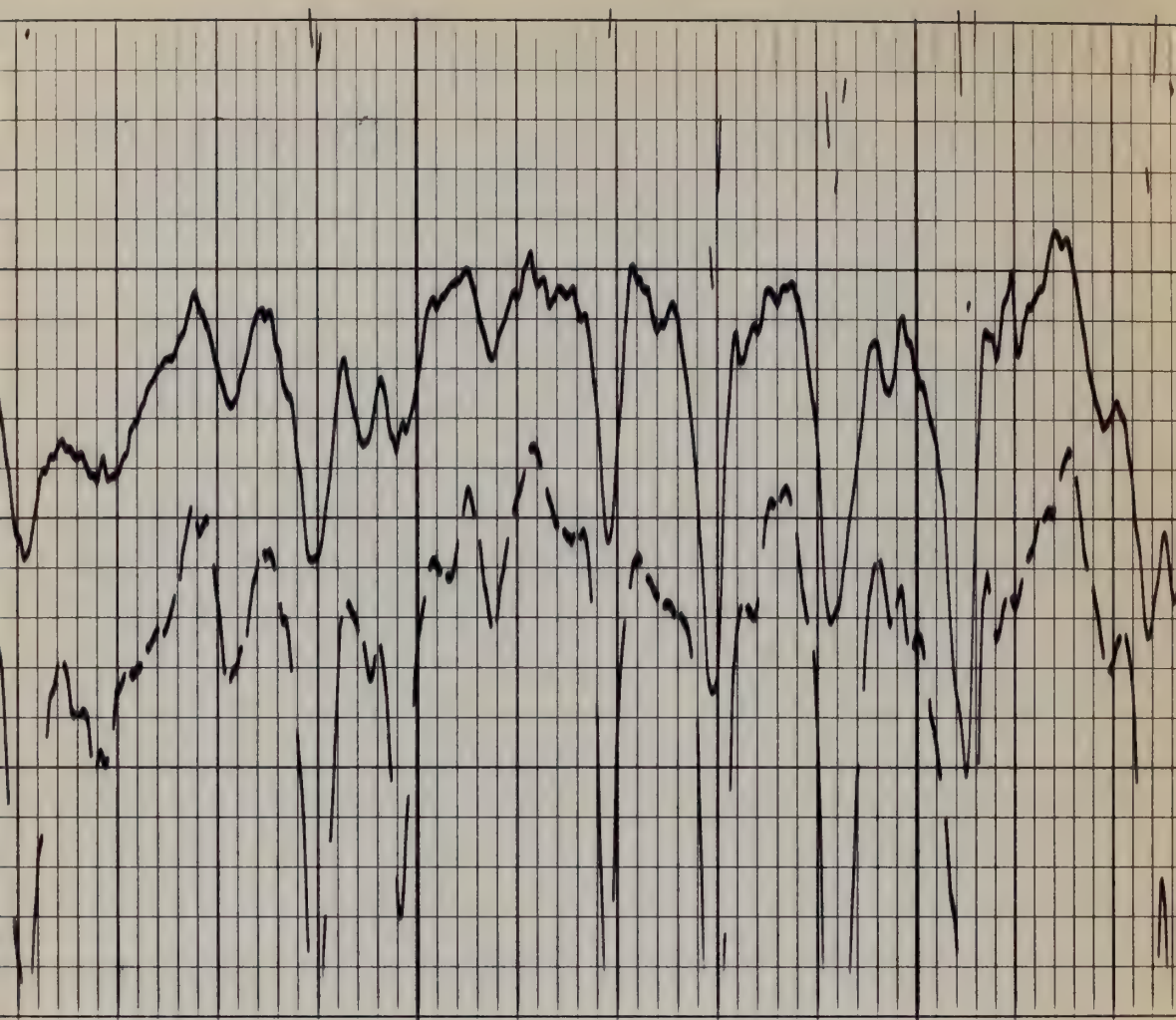




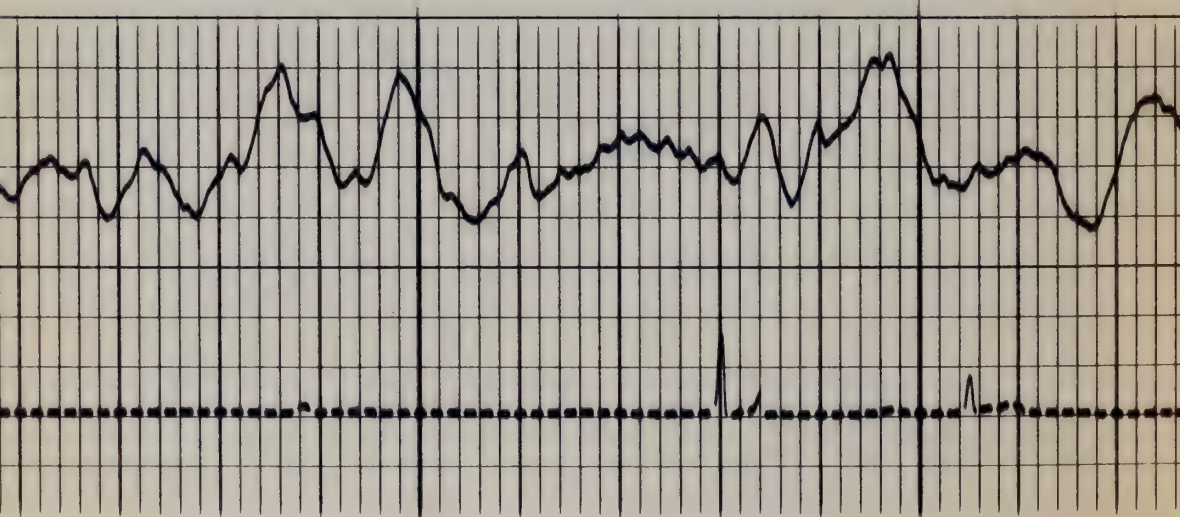
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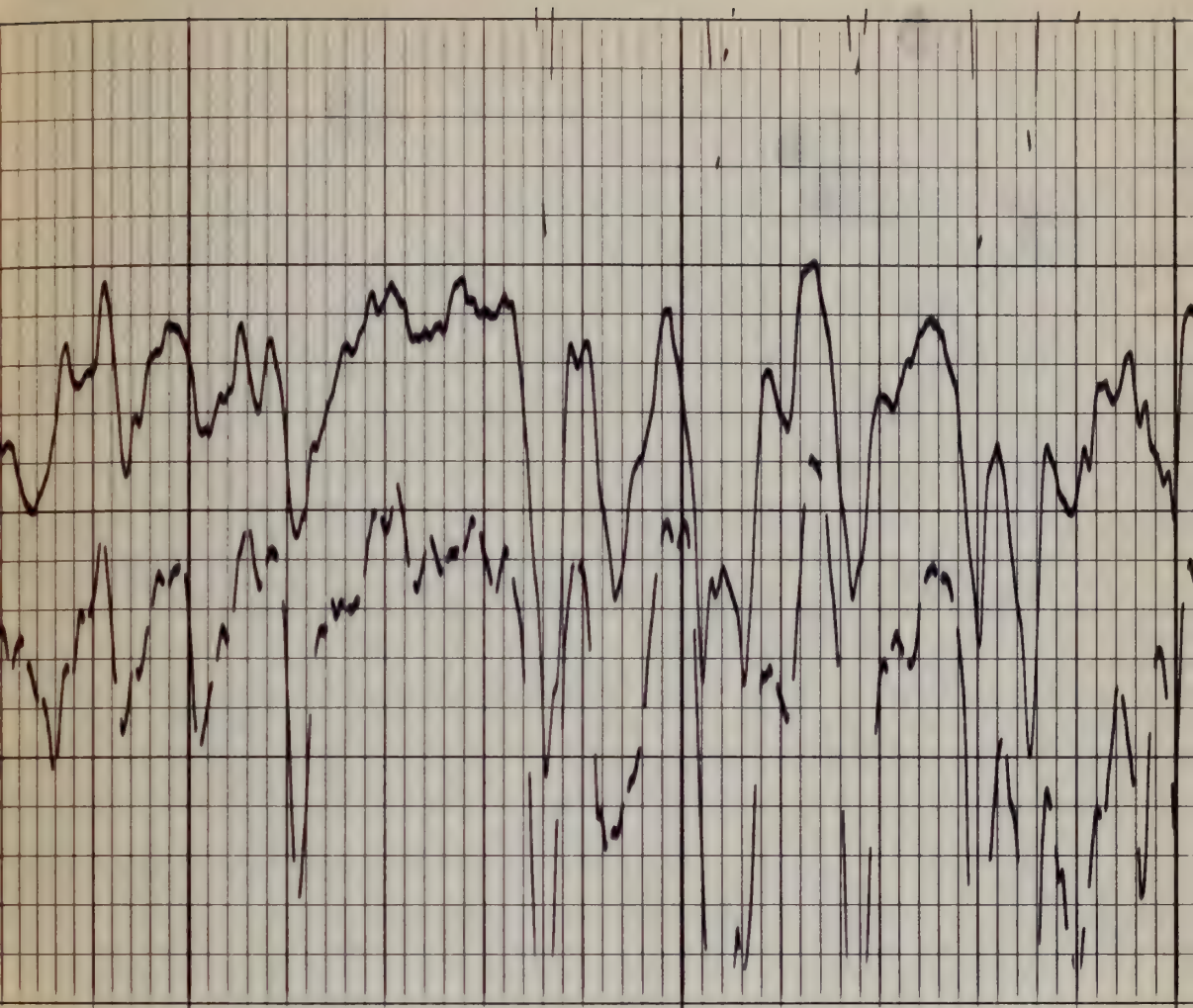
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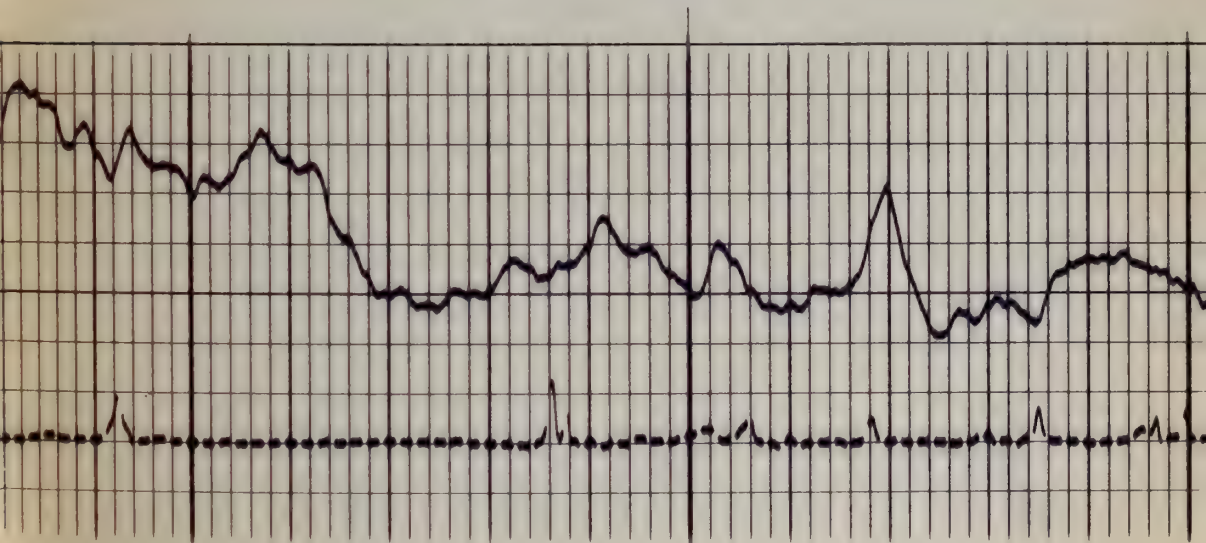


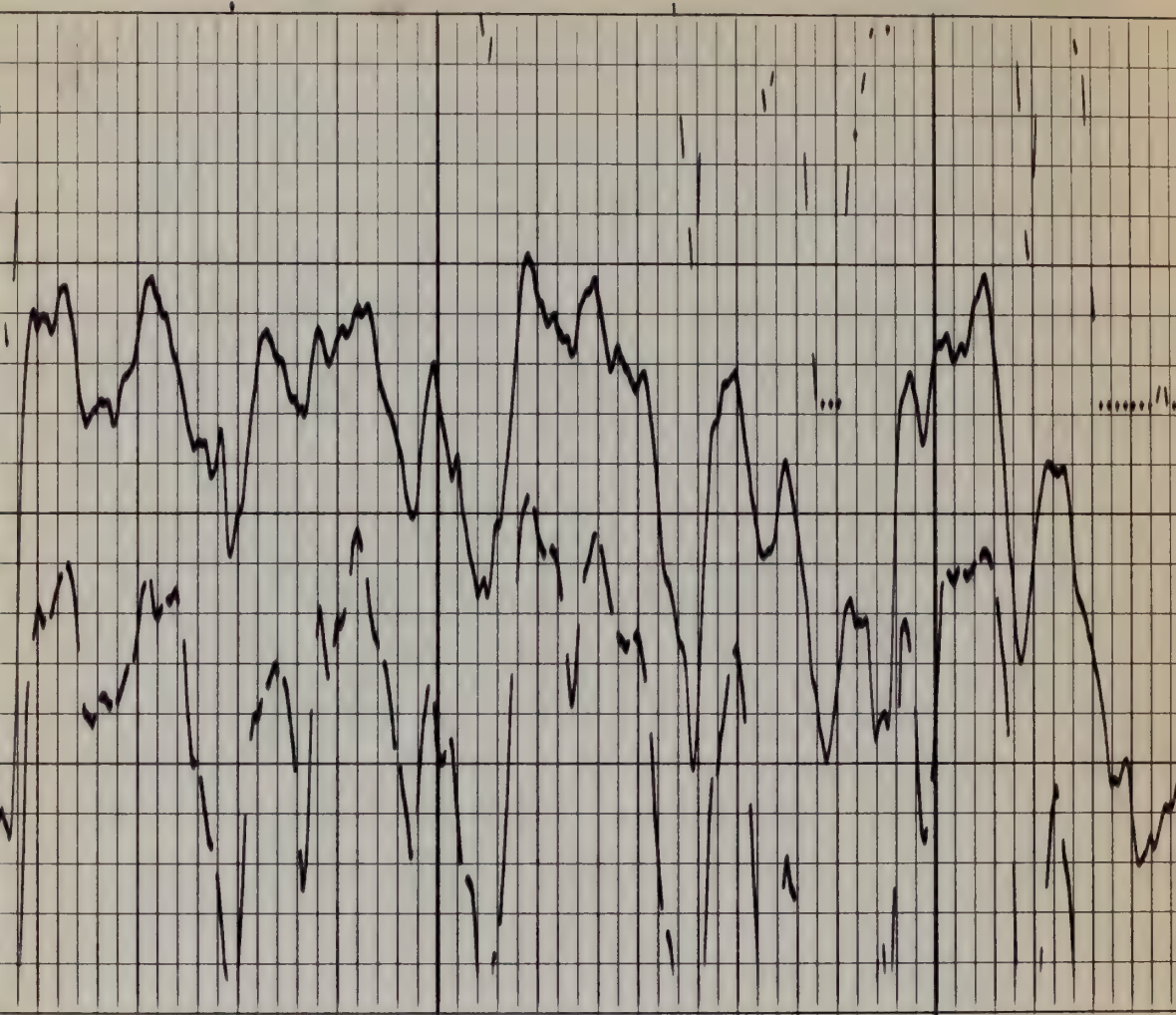
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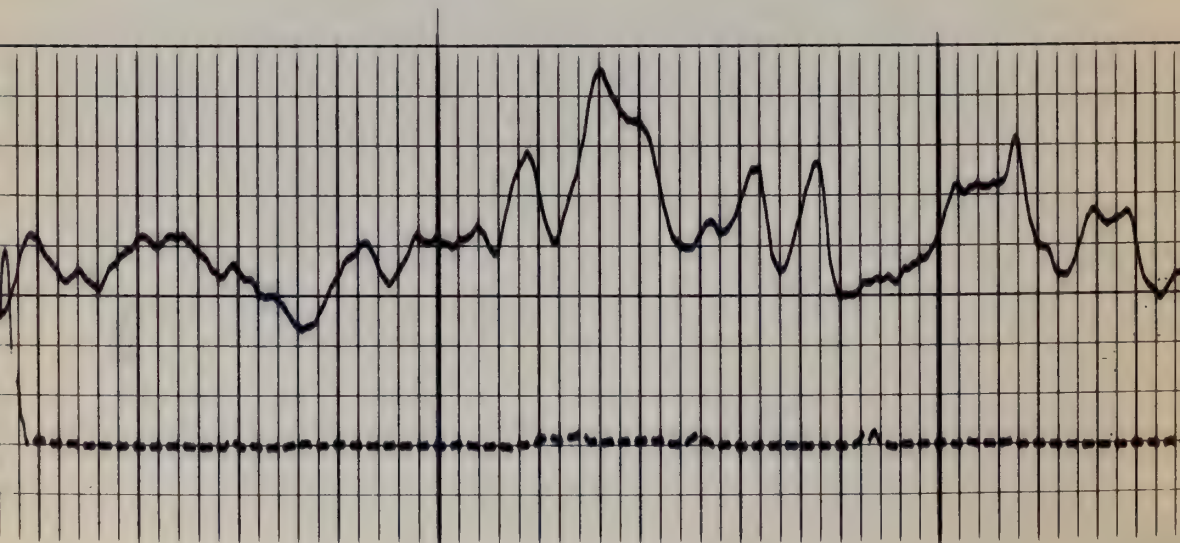


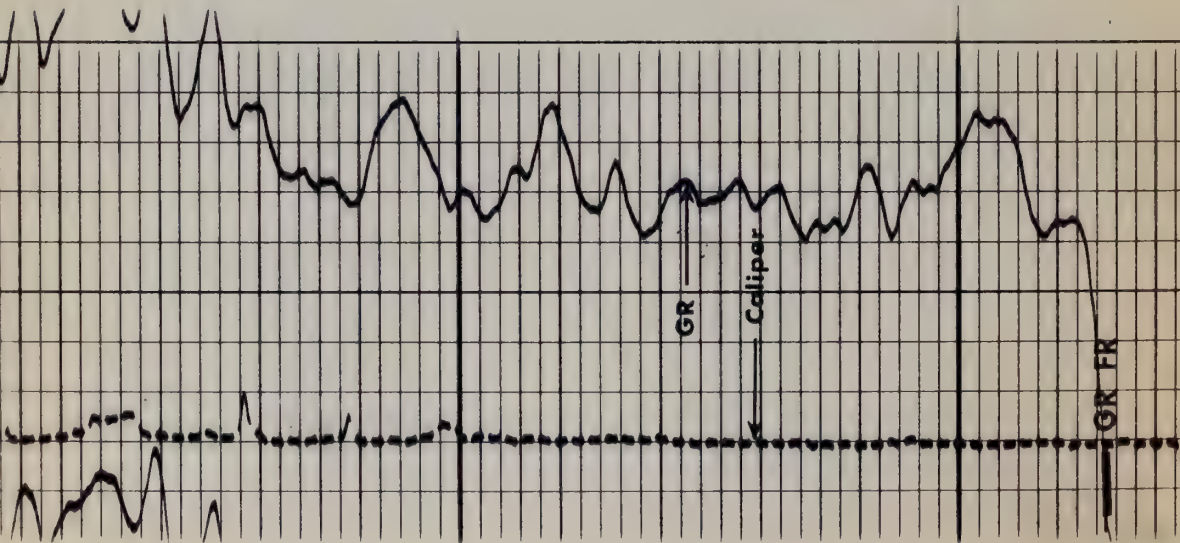
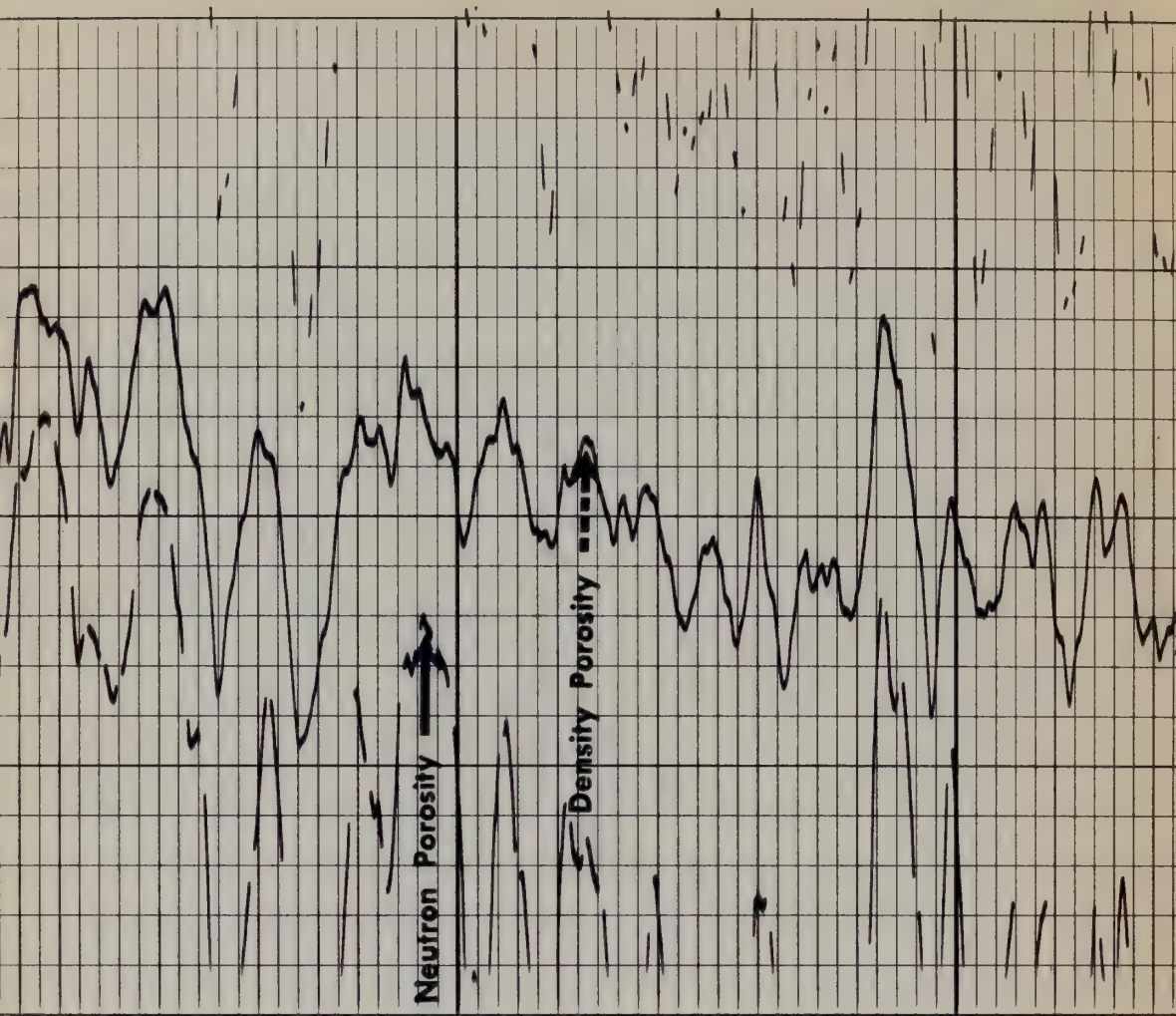
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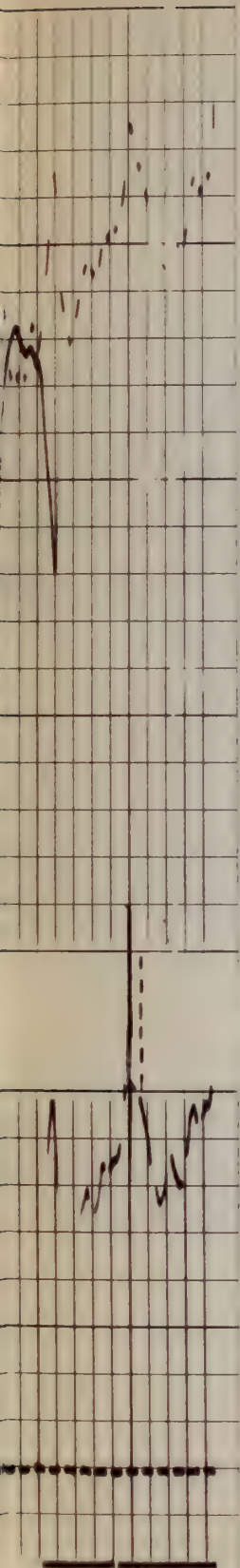




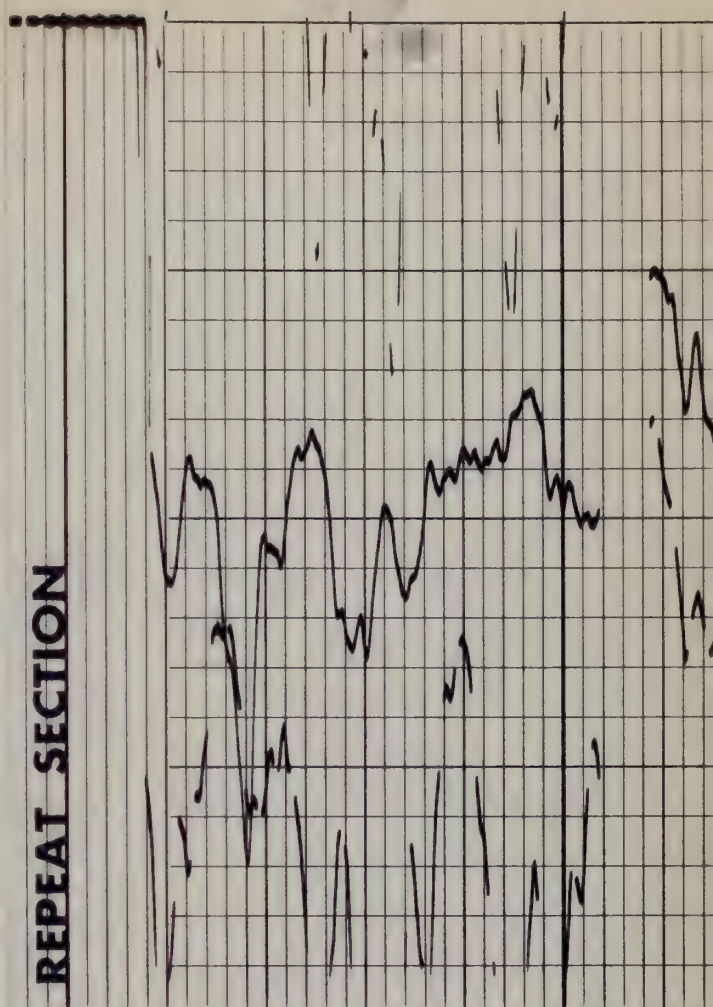
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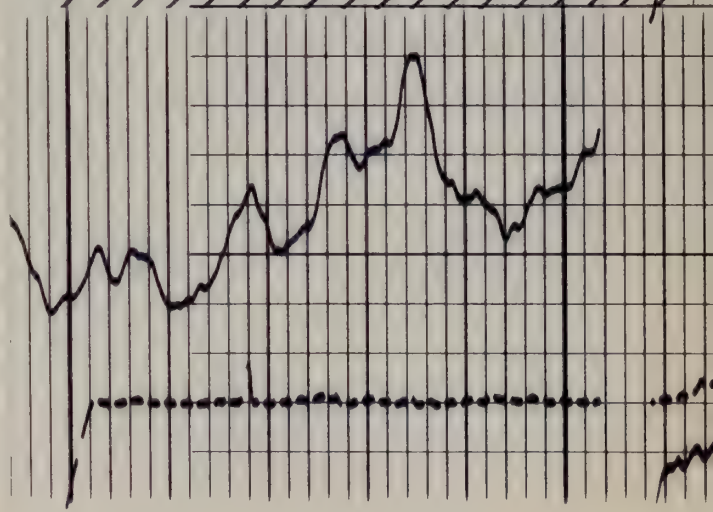


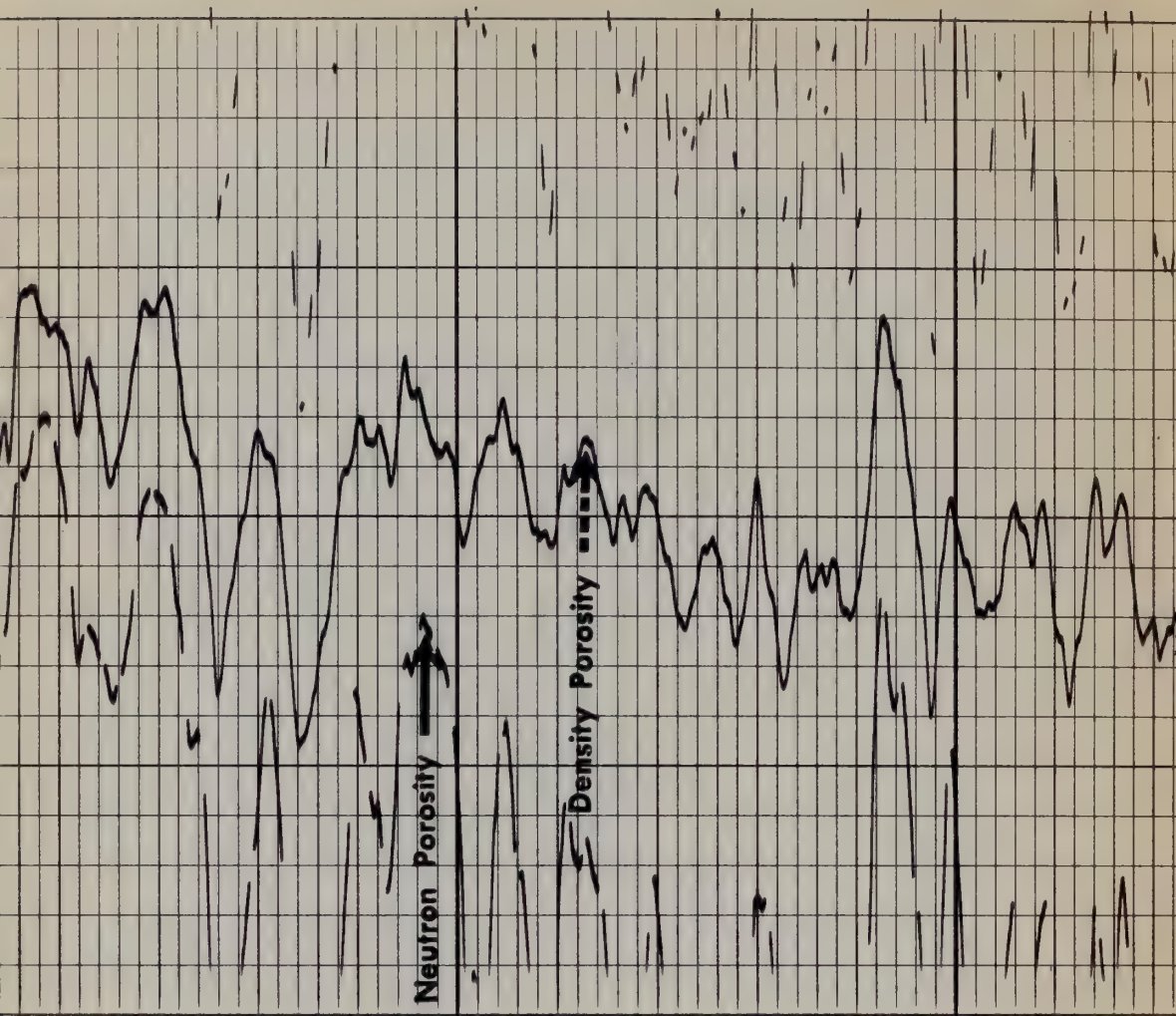


REPEAT SECTION

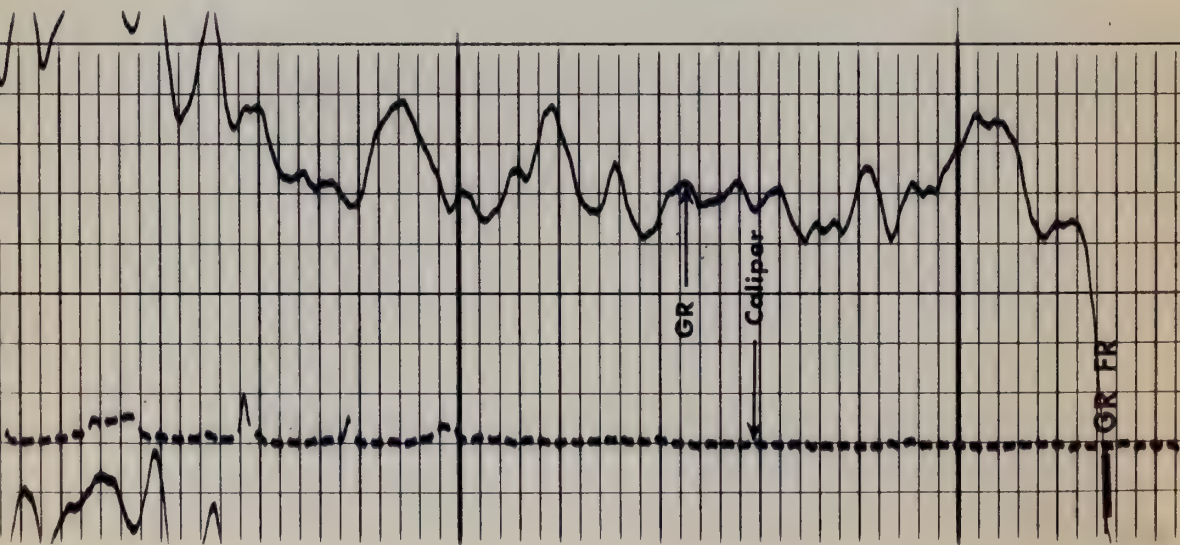


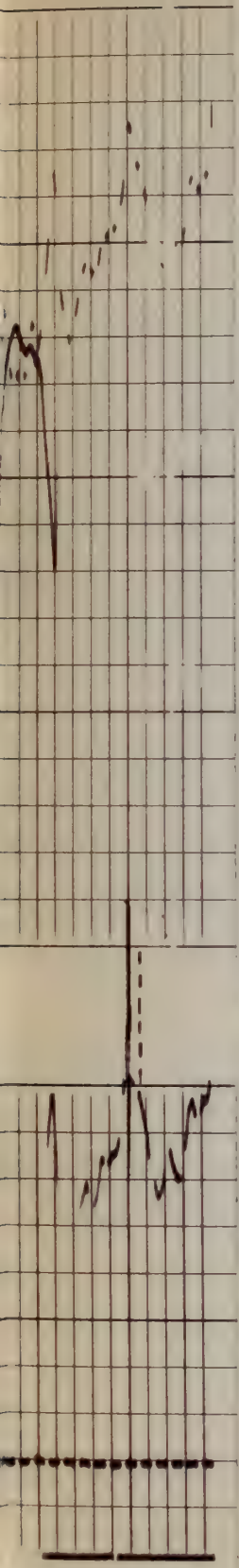
MEMORIZER OUT — CURVES INVALID



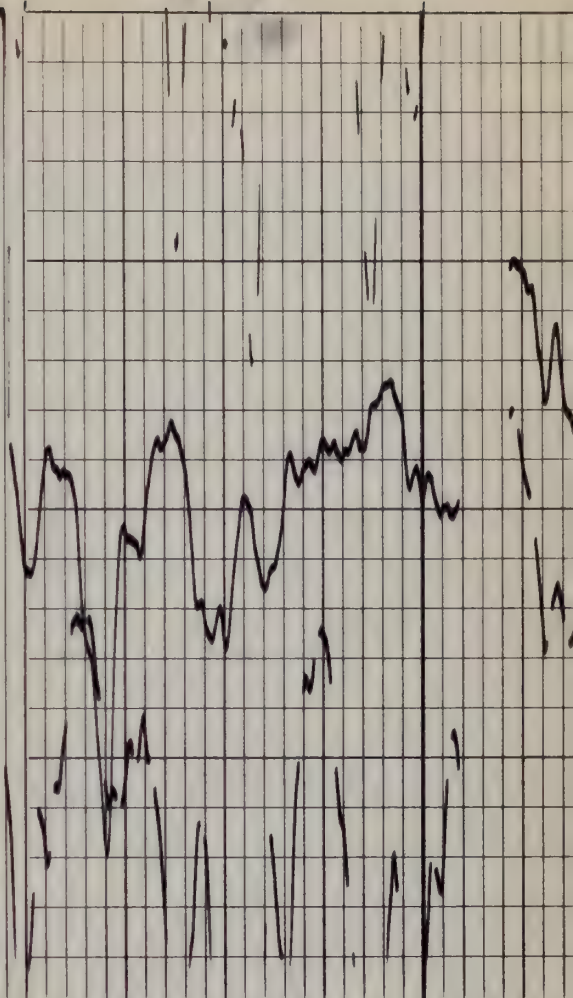


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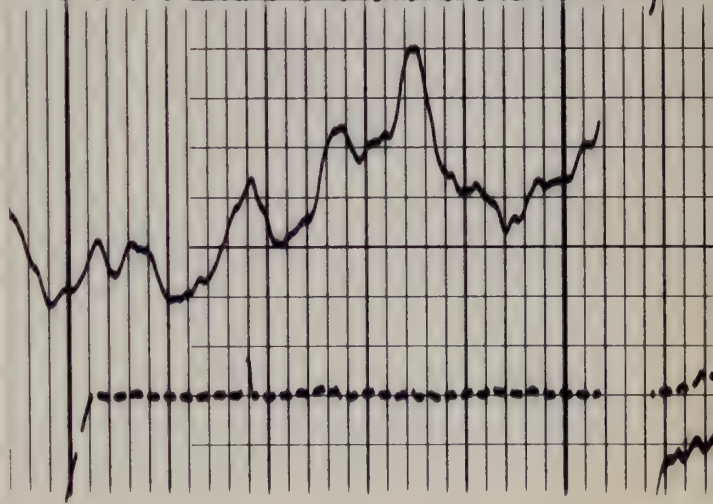


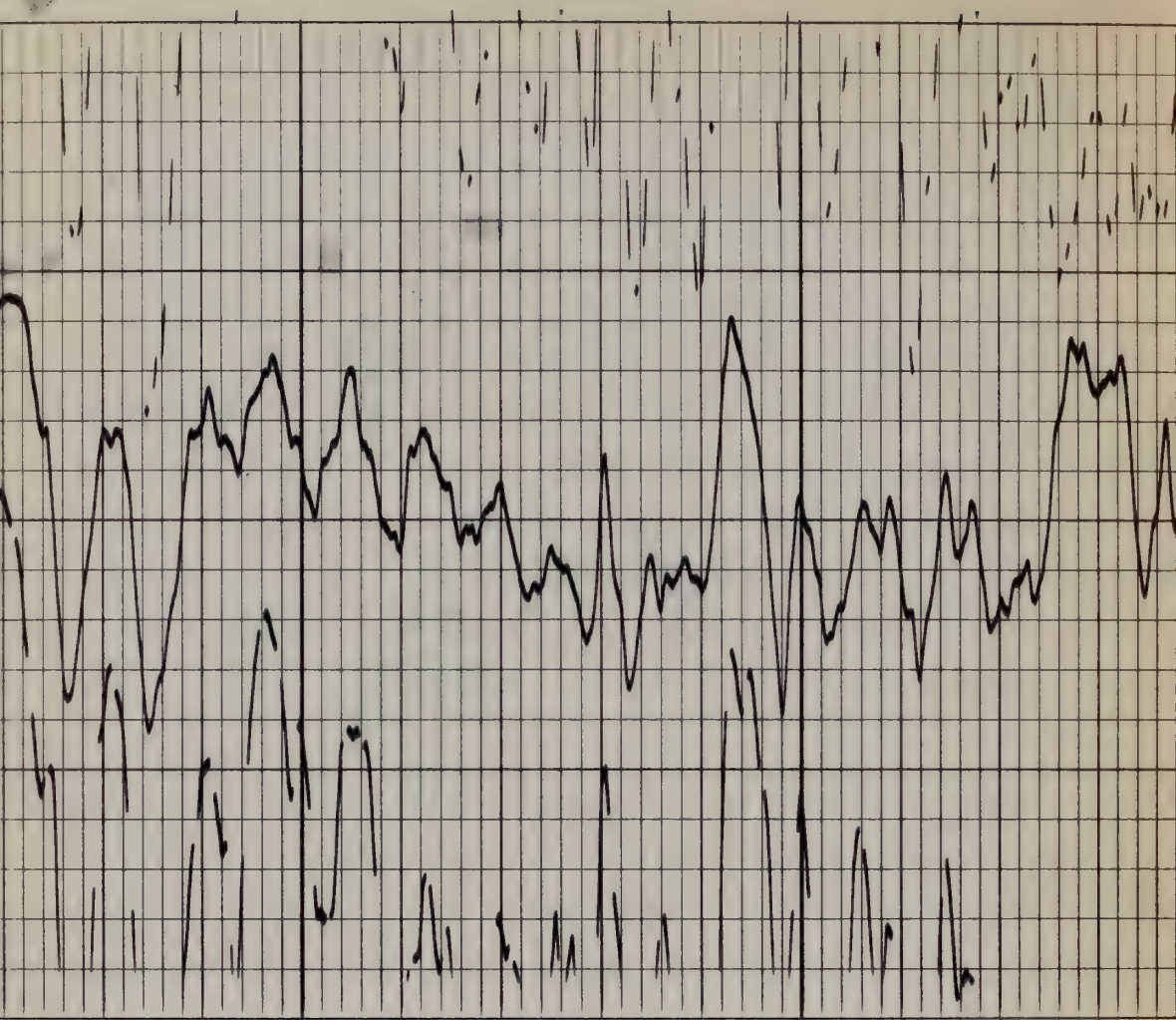


REPEAT SECTION

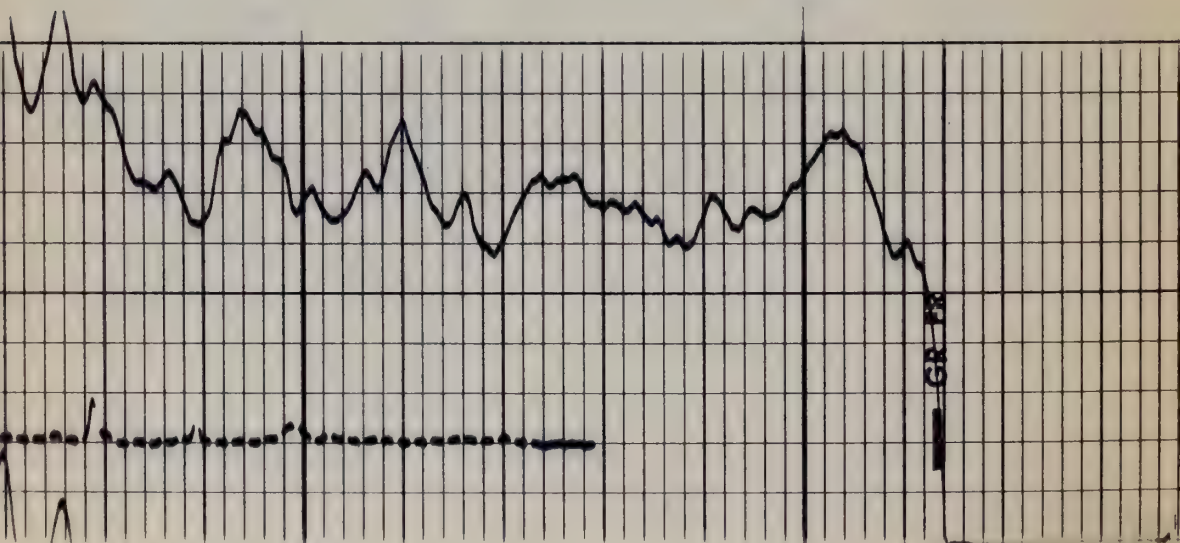


MEMORIZER OUT — CURVES INVALID





1600



91

HOLE DIAM. IN INCHES
CALIPER

051

300

GAMMA RAY

API UNITS

THE ATLANTIC RICHFIELD COMPANY

WELL _____ AQUIFER TEST NO. 1-B

一一一

COUNTY RIO BLANCO STATE COLORADO

SCHI FR 1640

SCHL. TD 1641

DRLR TD 1638

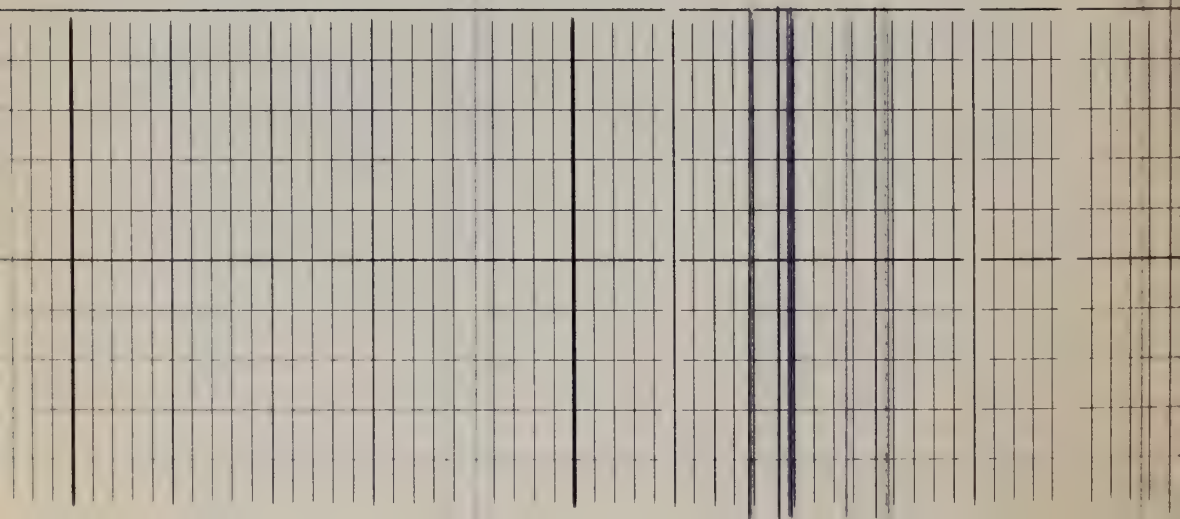
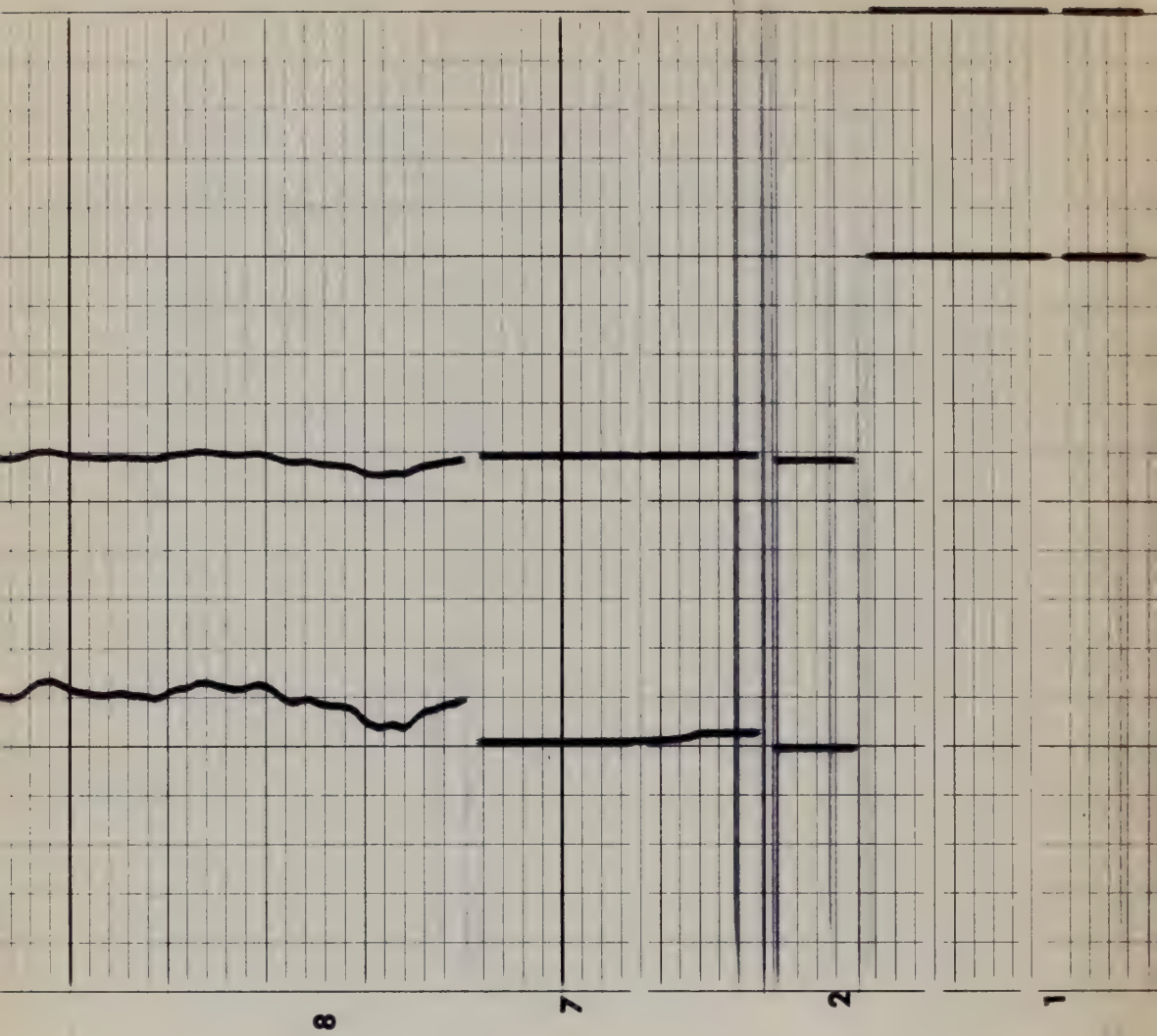
Elev:

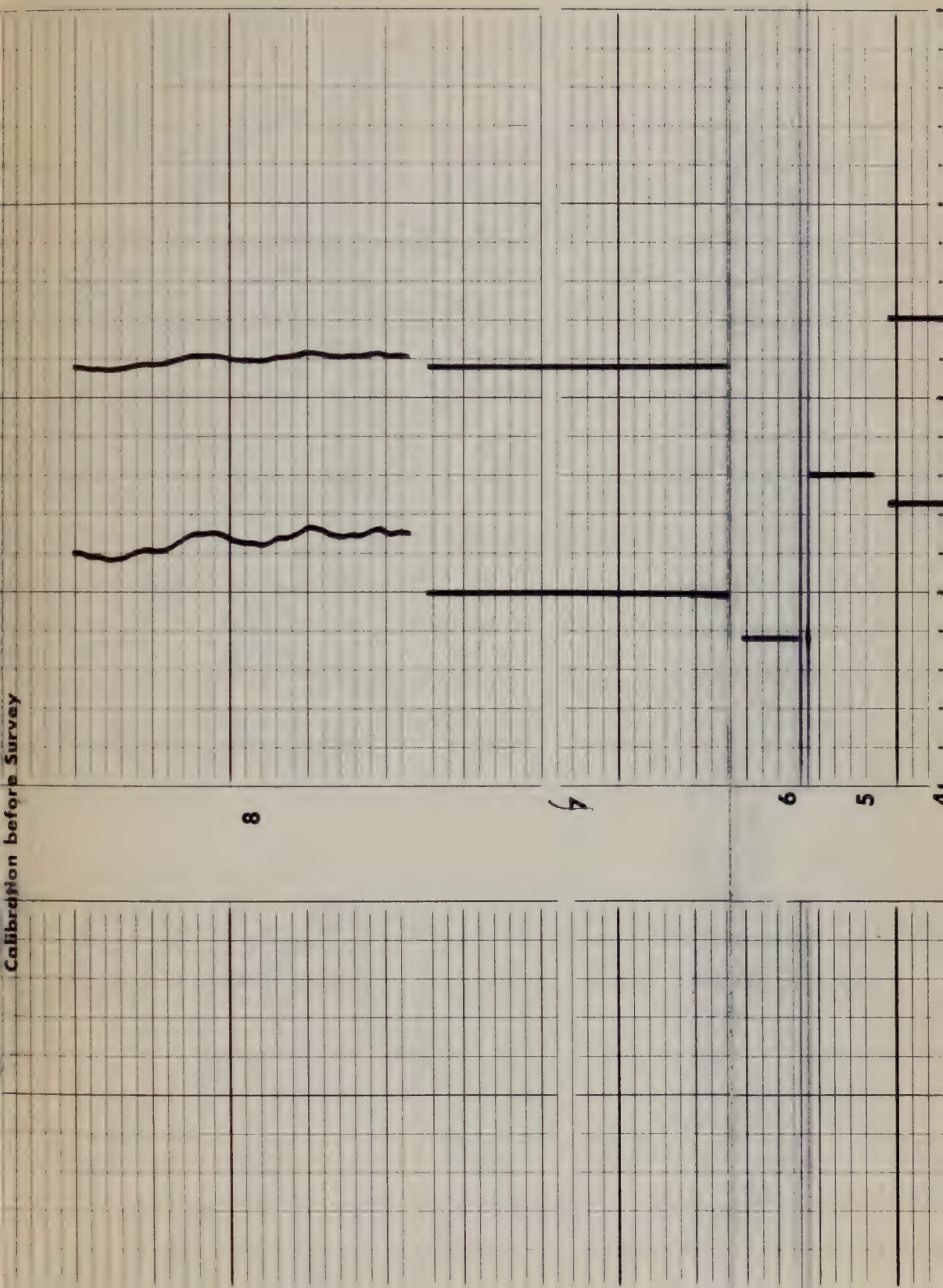
KB _____
 000 000 000 000

DF ---

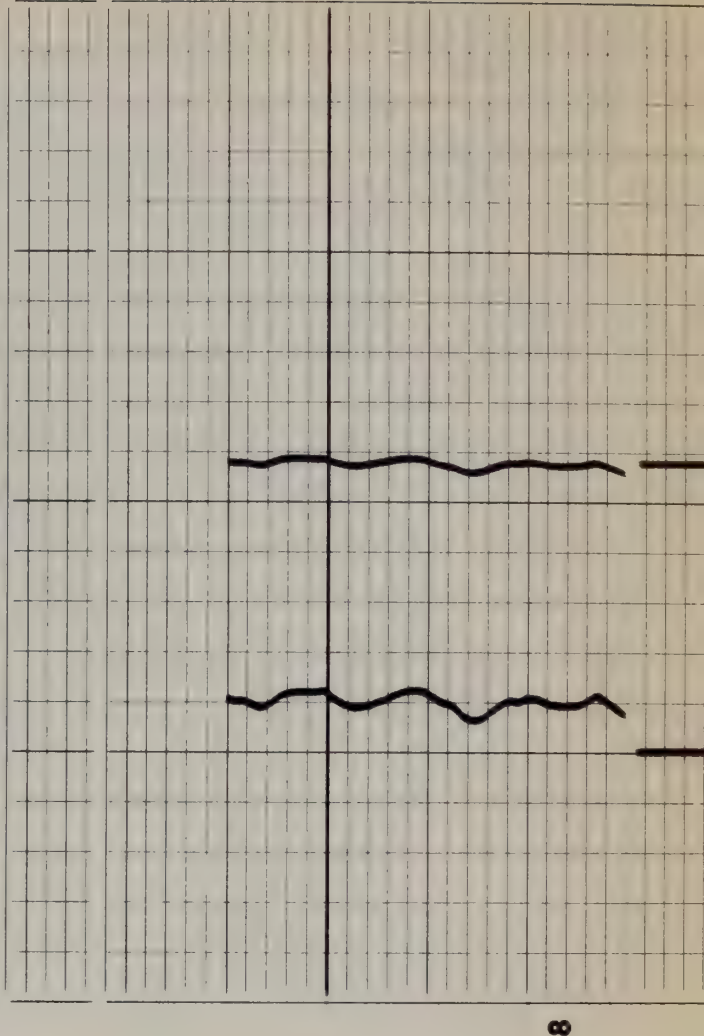
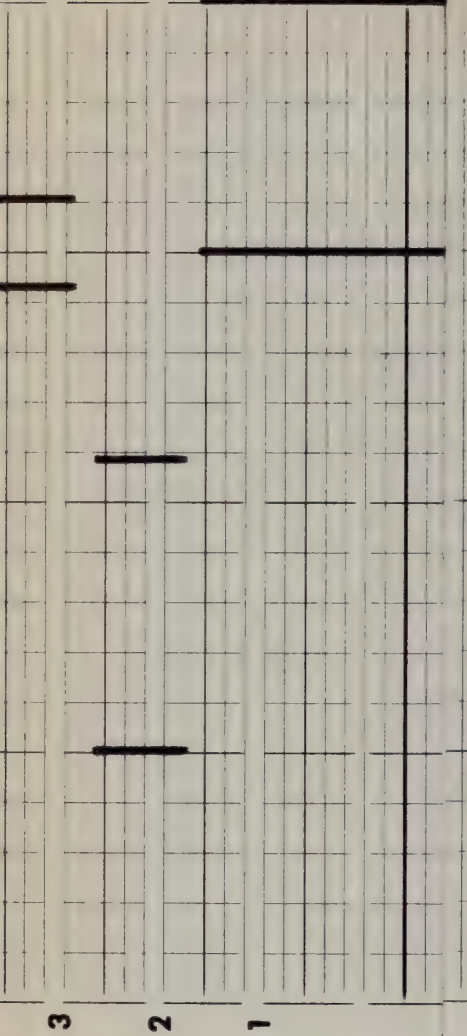
6909 GL

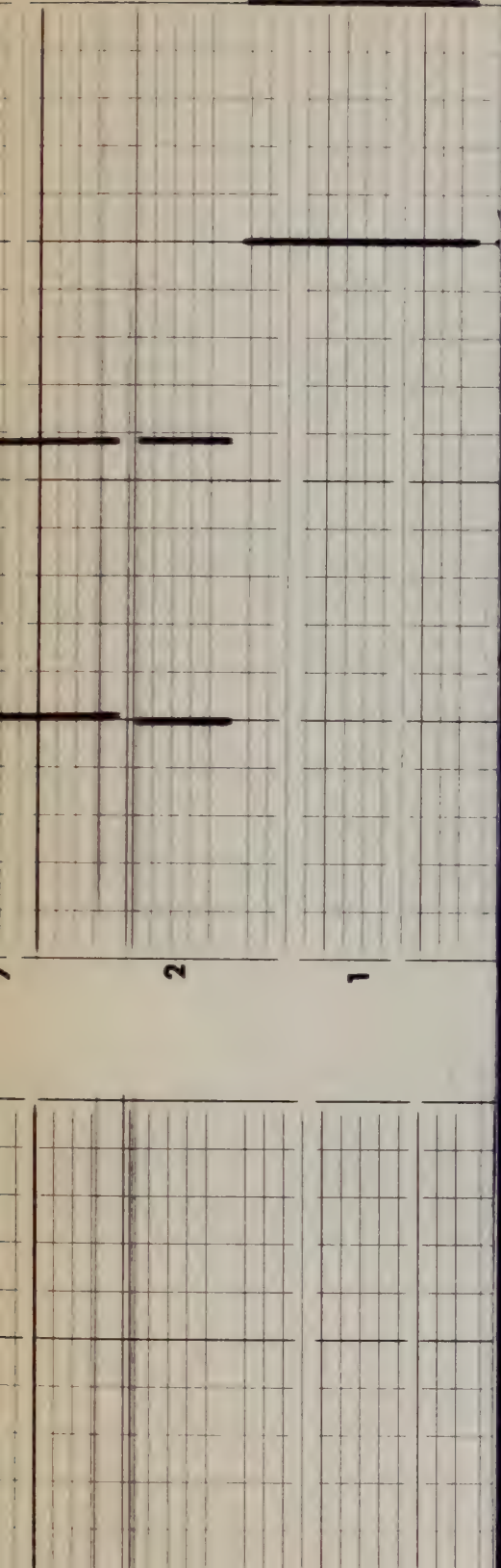
CALIBRATION RECORD





Shop
Calibration





COMPENSATED NEUTRON CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDED SENSITIVITY (THRU MEMORIZER IF USED)

PANEL TEST

RATIO	OH POROSITY		CH POROSITY	
	LS <input type="checkbox"/>	SS <input type="checkbox"/>	SS <input type="checkbox"/>	LS <input type="checkbox"/>
3.	1.6	4.9	2.4	0.1
4.	15.6	19.7	13.0	9.0
5.	31.3	36.0	29.1	24.1
6.	52.2	61.4	52.2	45.2

7. POROSITY NORMALIZED WITH CNB-A IN PLACE

7A. TOOL IN NCT-B

LOG POSITION WITH CNB-A IN PLACE

8A. LOG POSITION WITH TOOL IN NCT-B

OH		CH	
LS	SS	SS	LS
18	22.2	15.3	11.2

$$\text{RATIO (NORMALIZED)} = \frac{\text{RATIO (NCT-B)}}{\text{RATIO LOG}}$$

FORMATION DENSITY COMPENSATED CALIBRATION CODING

1. MECHANICAL ZERO
2. RECORDER SENSITIVITY

PANEL TEST

FDC LIQUID

POS	$\frac{\rho}{\Delta \rho}$
# 1	.00
# 2	+.14
# 3	-.10
# 4	.00
# 5	.01

MECHANICAL ZERO CALIPER

9. 8" RING
10. 12" RING
11. TOOL CALIBRATE #1 SET $\rho = 2.50$
12. TOOL CALIBRATE #2 SET $\Delta \rho = .00$
13. LOG POSITION $\rho = 2.59, \Delta \rho = .015$



CALIBRATION RECORD

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

SCHL. FR 1640

SCHL. TD 1641

DRLR TD 1638

Elev: -----

KB -----

DF -----

GL 6909

ENGINEERED PRODUCTION LOGGING

Schlumberger

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD ----

COUNTY RIO BLANCO STATE COLORADO

LOCATION:

Sec. 7 Twp. 3S Rge. 96W

SERVICES RUN:

DIL
FDC-GR
CNL-GR
BHC-GR

Permanent Datum: GL Elev.: 6909

Log Measured From: GL
Drilling Measured From: GL

ELEVATION:

KB
DF ----
GL 6909

Equipment Location: 5602-GRAND JUNCTION

Recorded by: SCHNORR DATE: 7-21-74

Witnessed by: TAIT

Log depths of these records relate to: ☒ Schlumberger line measurements,

☐ correlated by CCL to Radioactivity Log Measurements.

Schlumberger Depths

WELL SKETCH

Driller Depths

8-5/8" 72 FEET

60' -8-5/8"

FLUID LEVEL 420'

7-7/8" 1640

1638' -7-7/8"

Indicate: Hole deviation in production zone
Open hole diameter
Diameter and weight of casing and tubing
Position & nature of perforations (bullets, conventional SC, capsules, etc.)

the well name, location and borehole reference data were furnished by the customer.

FOLD HERE

Schlumberger

TEMPERATURE

	RUN #	PASS #	RUN #	PASS #	RUN #	PASS #	RUN #	PASS #
Date	7-21-74							
Production Method	STATIC							
Stabil. time before log	12 HRS.							
Hours log began	01:00							
Bottom logged interval	1637							
Top logged interval	40							
Film logged "Up" or "DOWN"	DOWN							
THP Static	psi							
THP Dynamic	psi							
BHP Static	psi							
BHP Dynamic	psi							
Well head temp. °F	61							
Surf. Prod. Rate								
Surf. Injection Rate								

SURFACE EQUIPMENT		DOWNHOLE EQUIPMENT				FLOWMETER		CFS	SSA	FAA	FBS
PPU	A-777K TEP	CEC	FAC		CCL						
PRU	GNP	CCE	FAA		GNT-K		Spinner Size				
PCU	ETU	MTS	HUM		SGT-G		Spinner Pitch				
HTU	A-730 CFP	GMS	SSA		ETC		REMARKS				
GMU		TCS	PSA		ETS						
CFU		FBS	MSA		PAC-A						
CMU		CFS	TEE		HTS-B						
FAU		PRC	TEC		TTC						

REDUCED SCALE TEMP.

DEPTHS

TEMPERATURE

°F

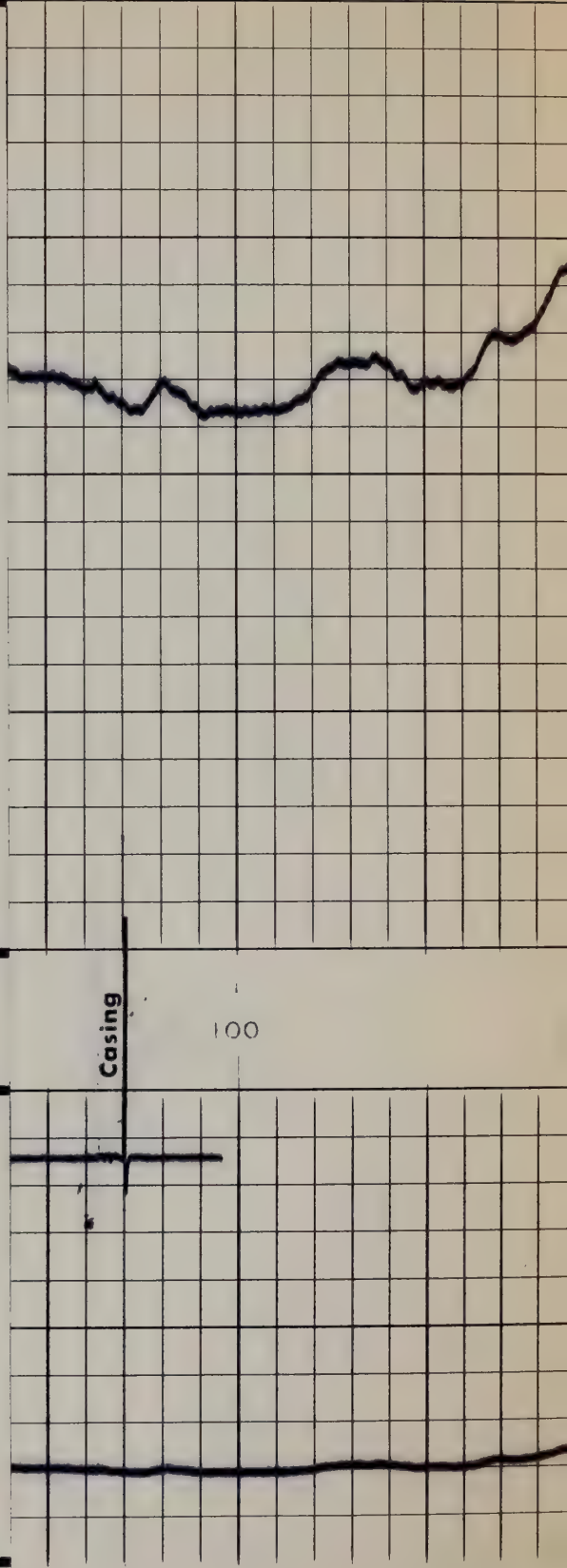
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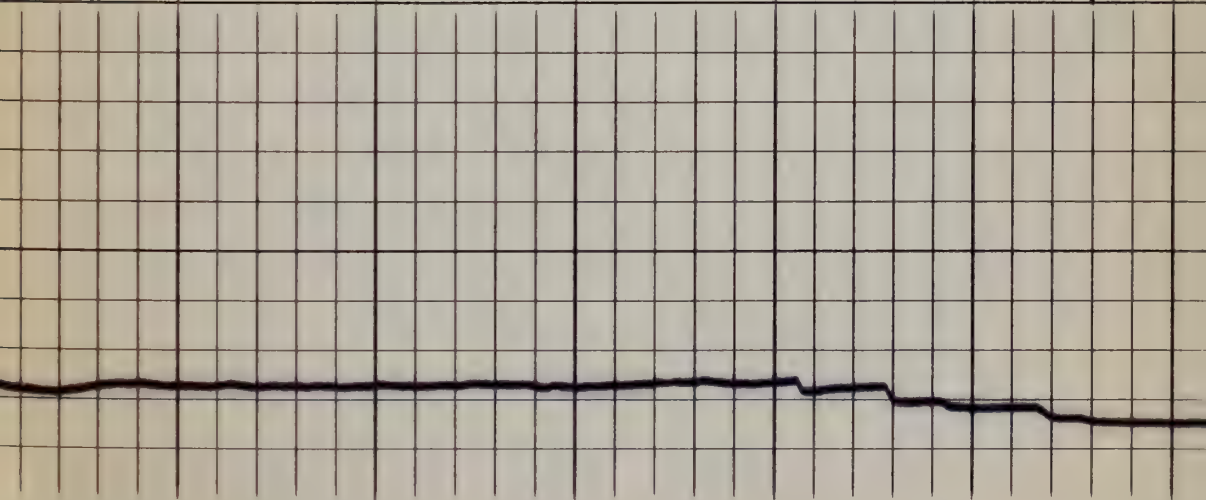
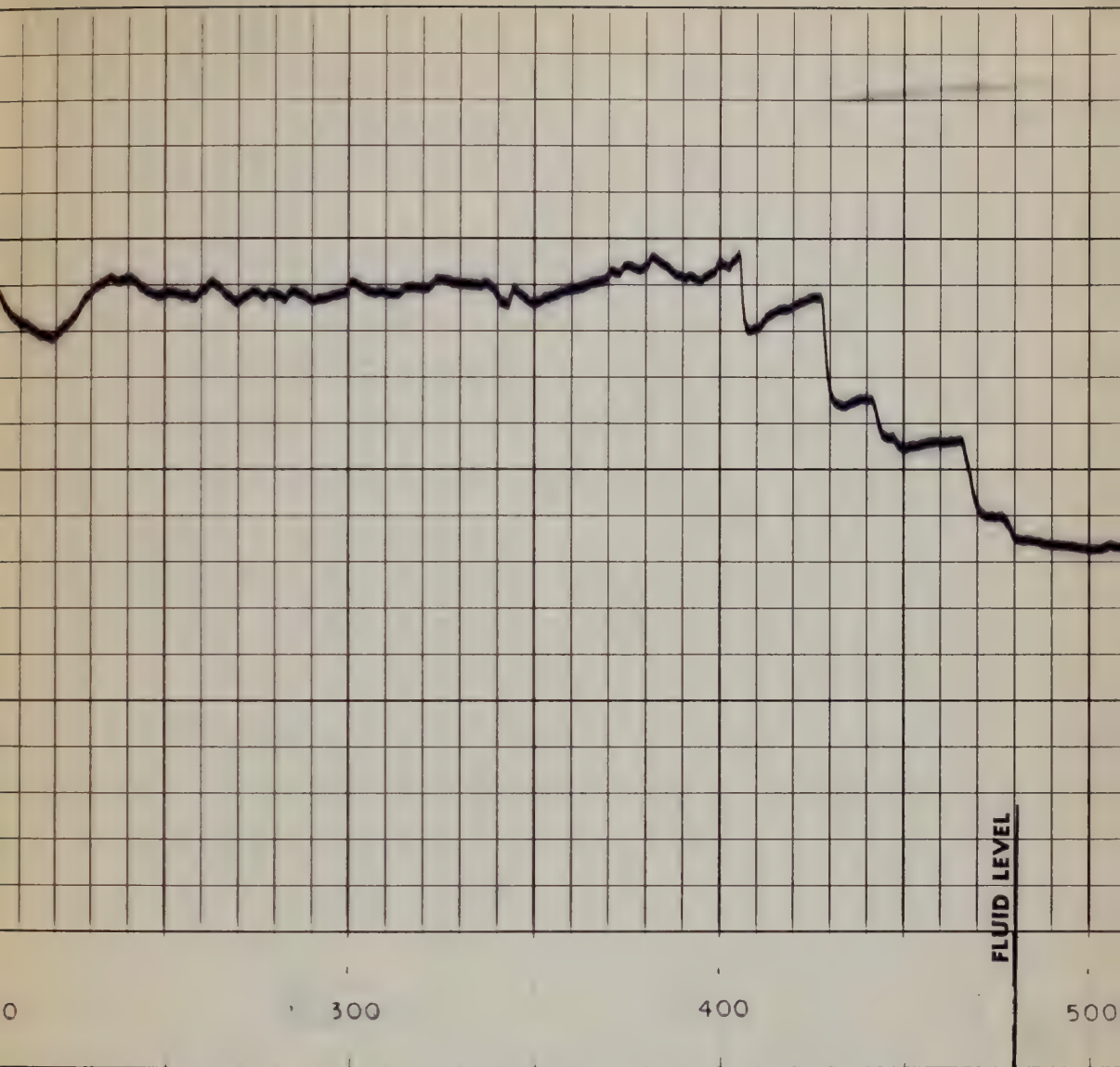
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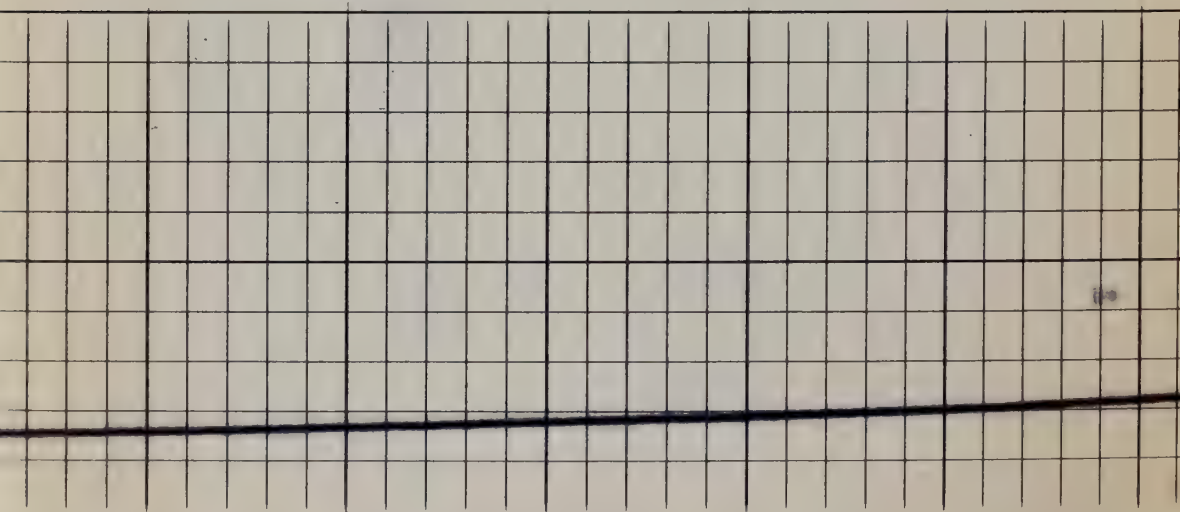
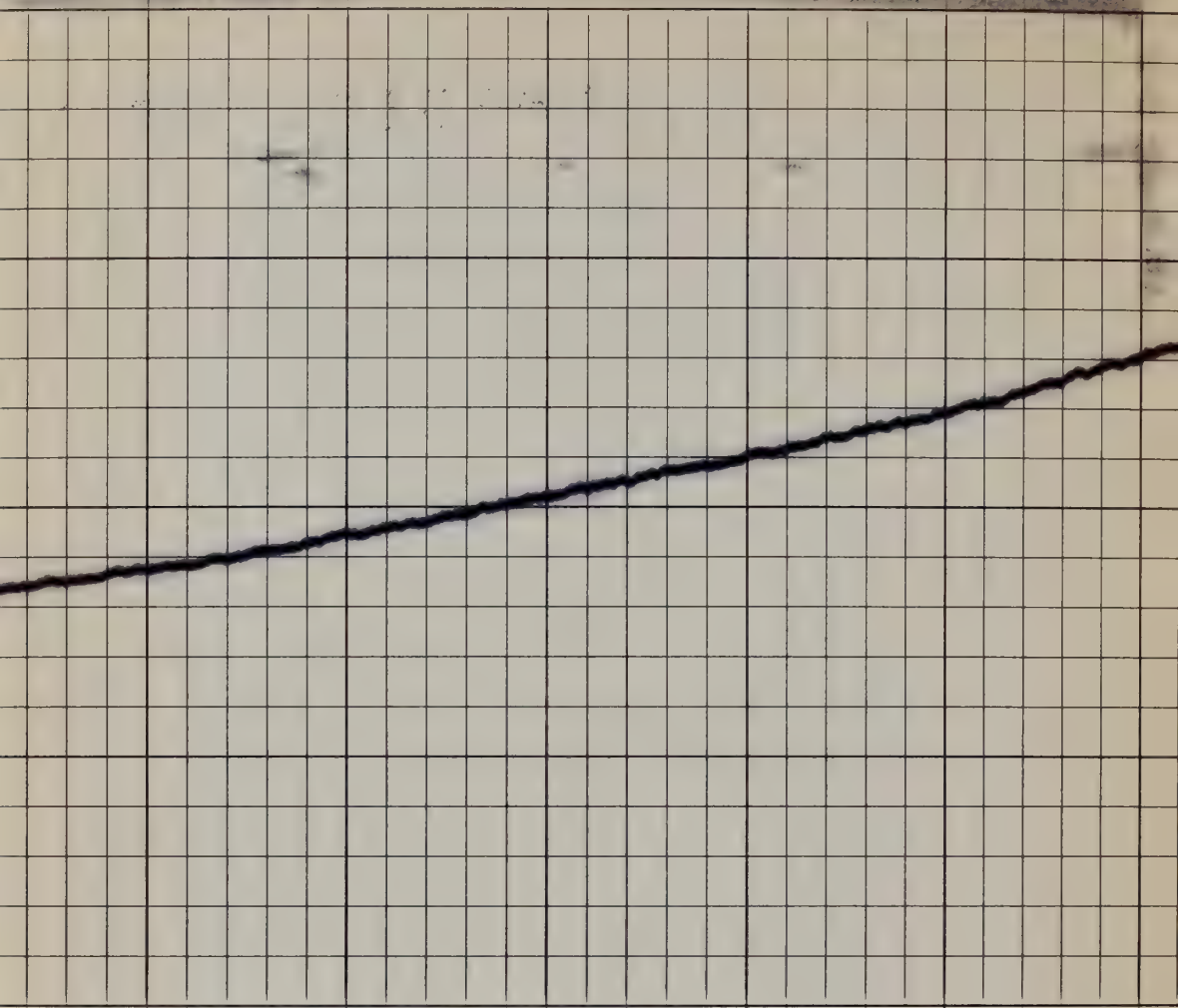
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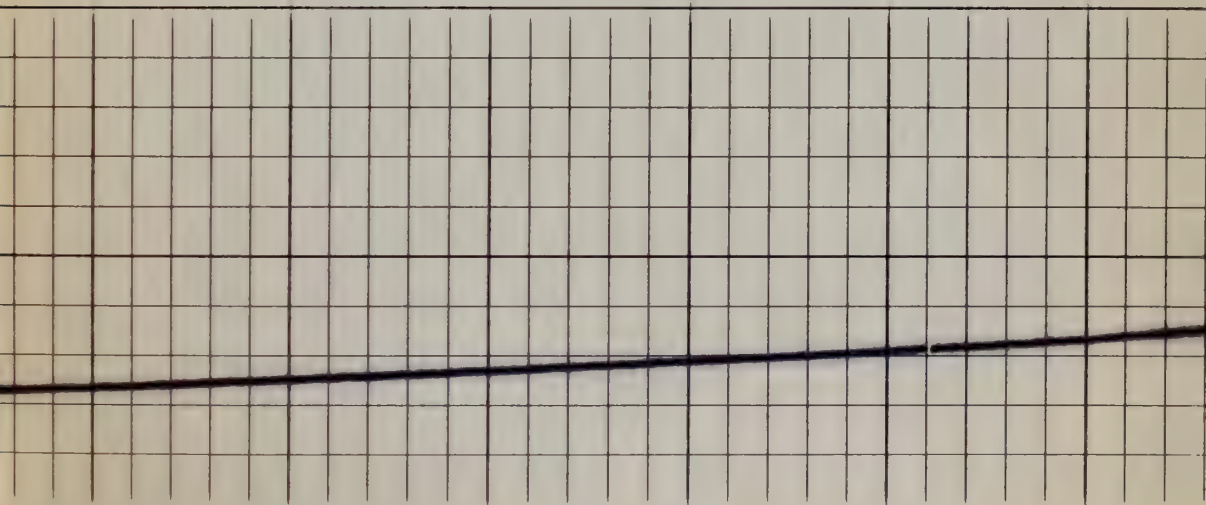
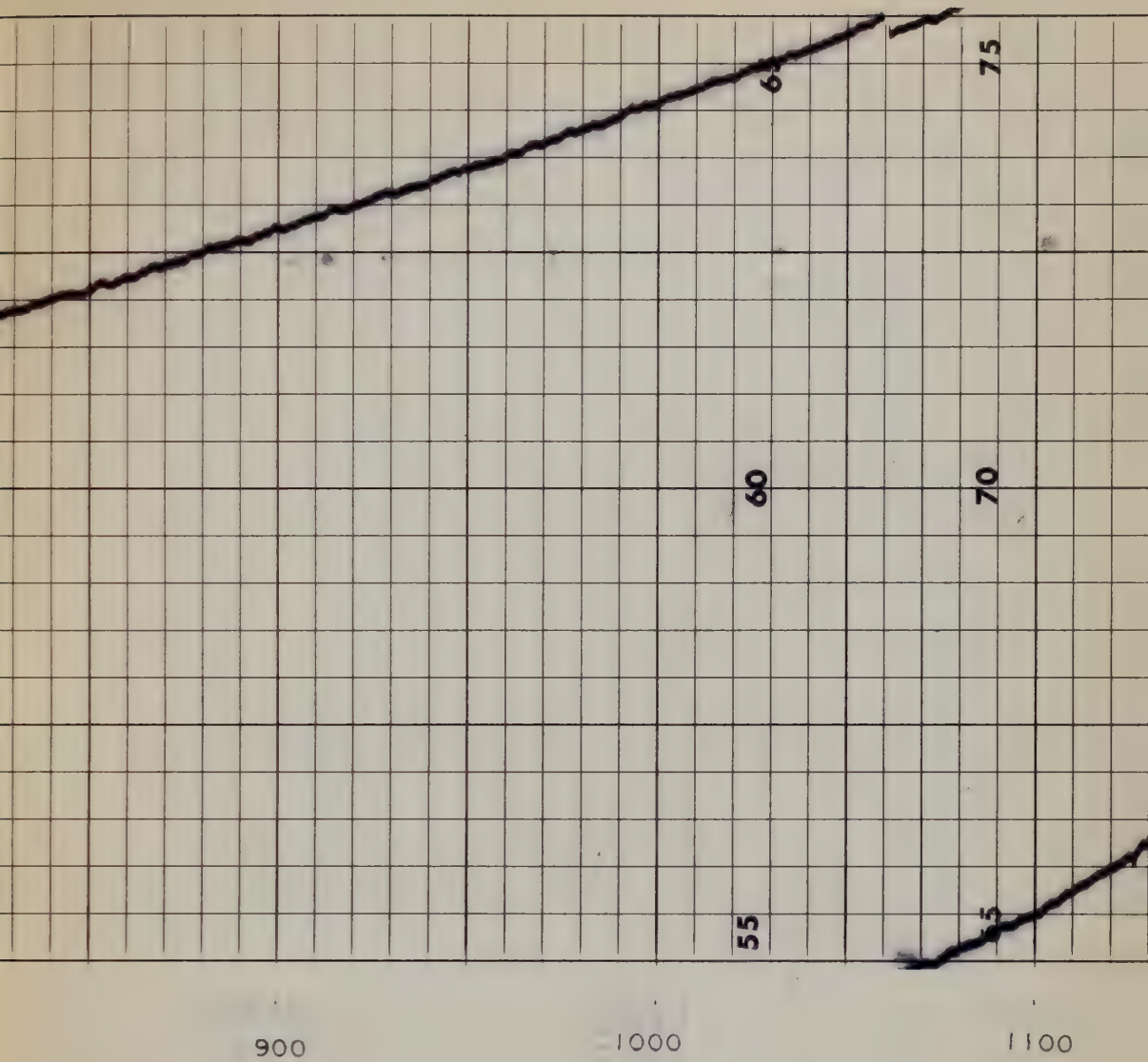
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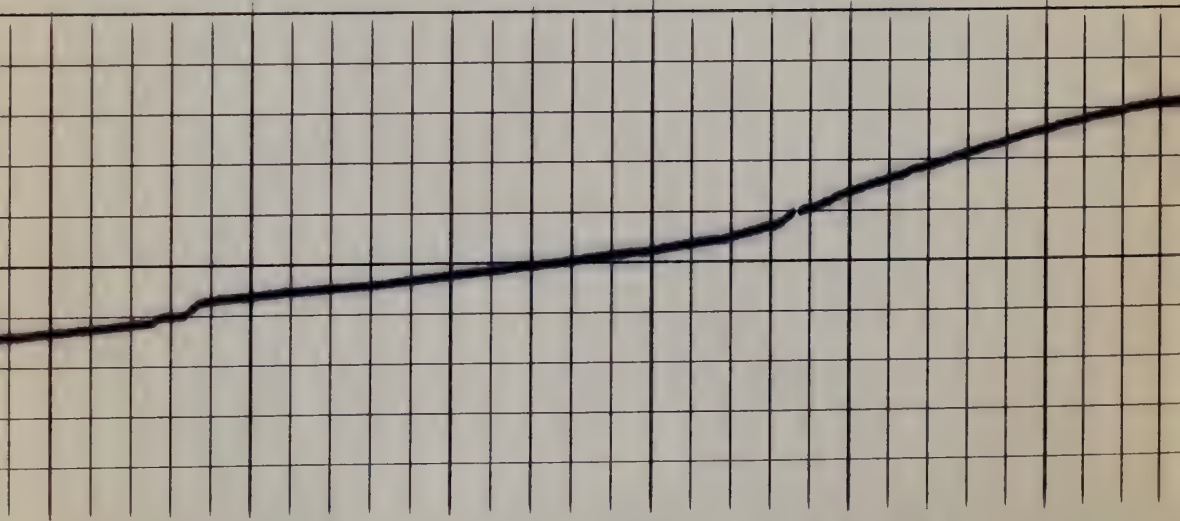
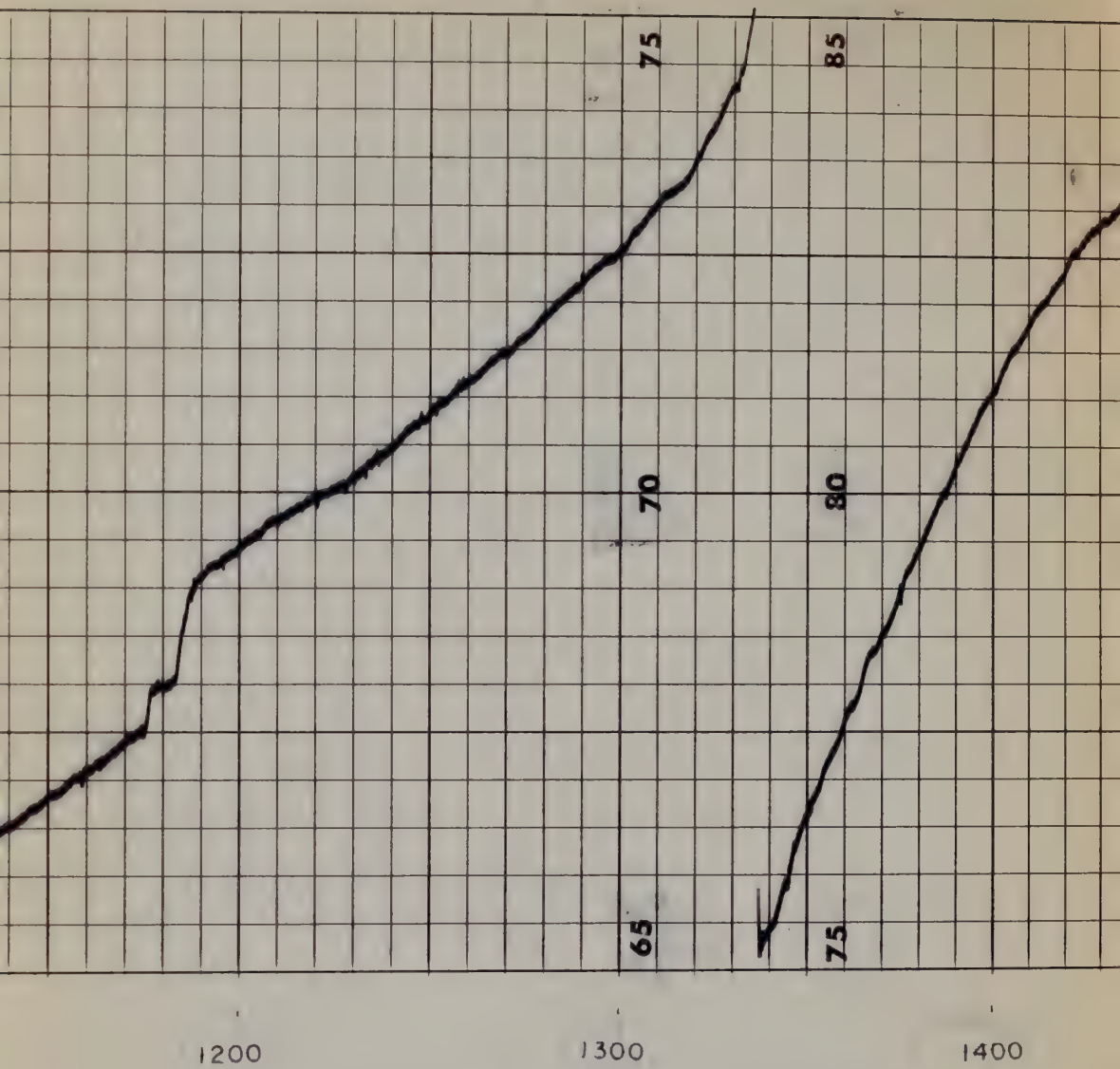
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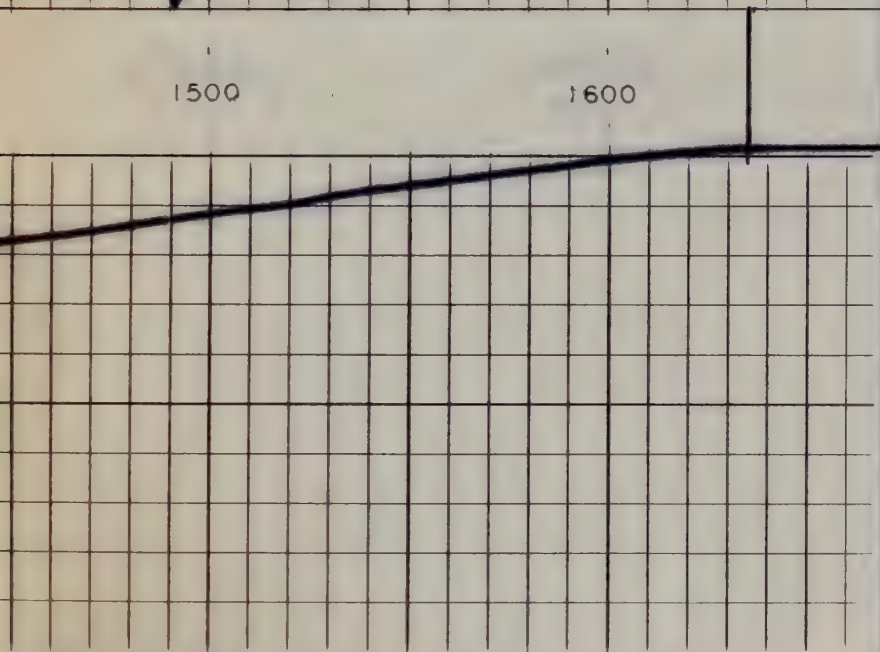
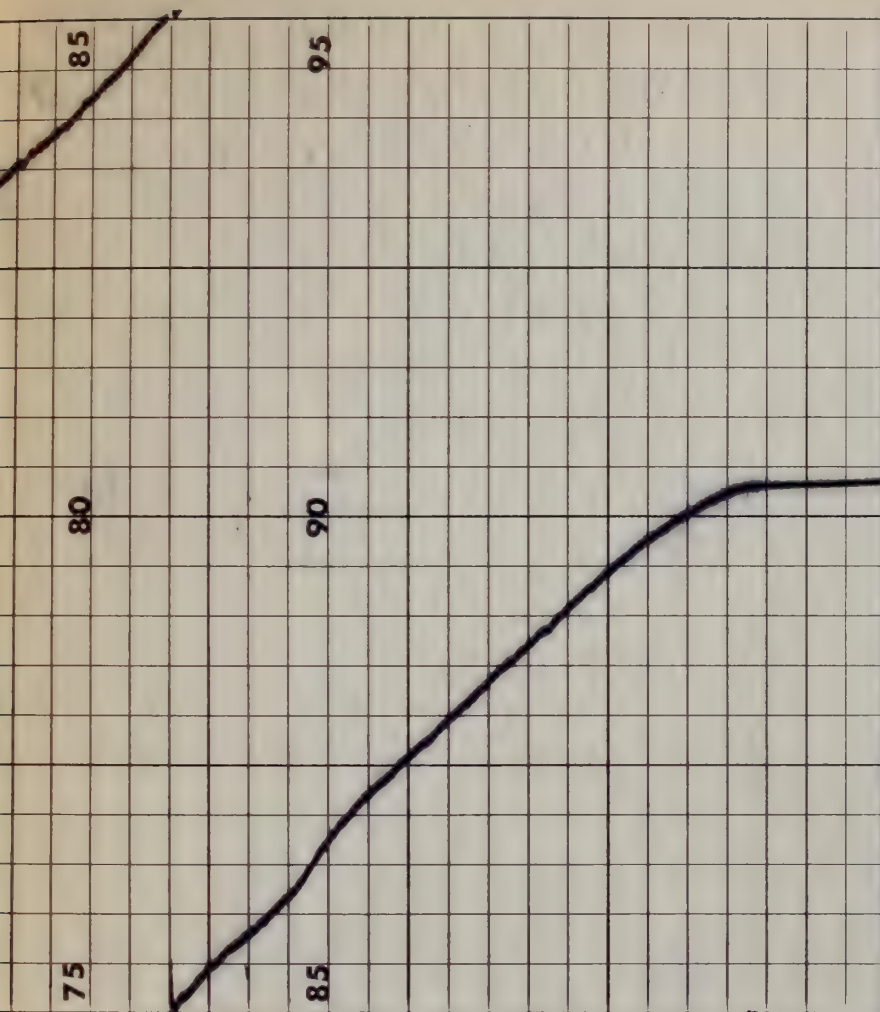












REDUCED SCALE TEMP.

REDUCED SCALE TEMP.

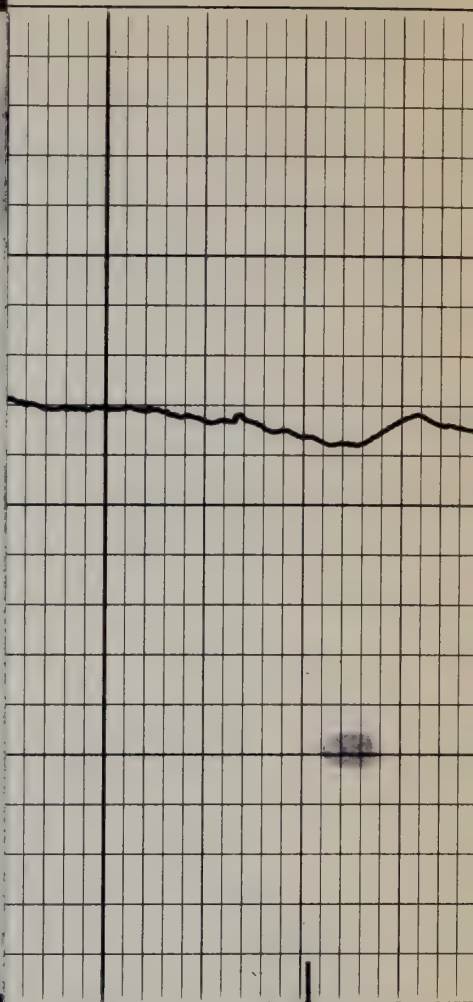
TEMPERATURE
° F

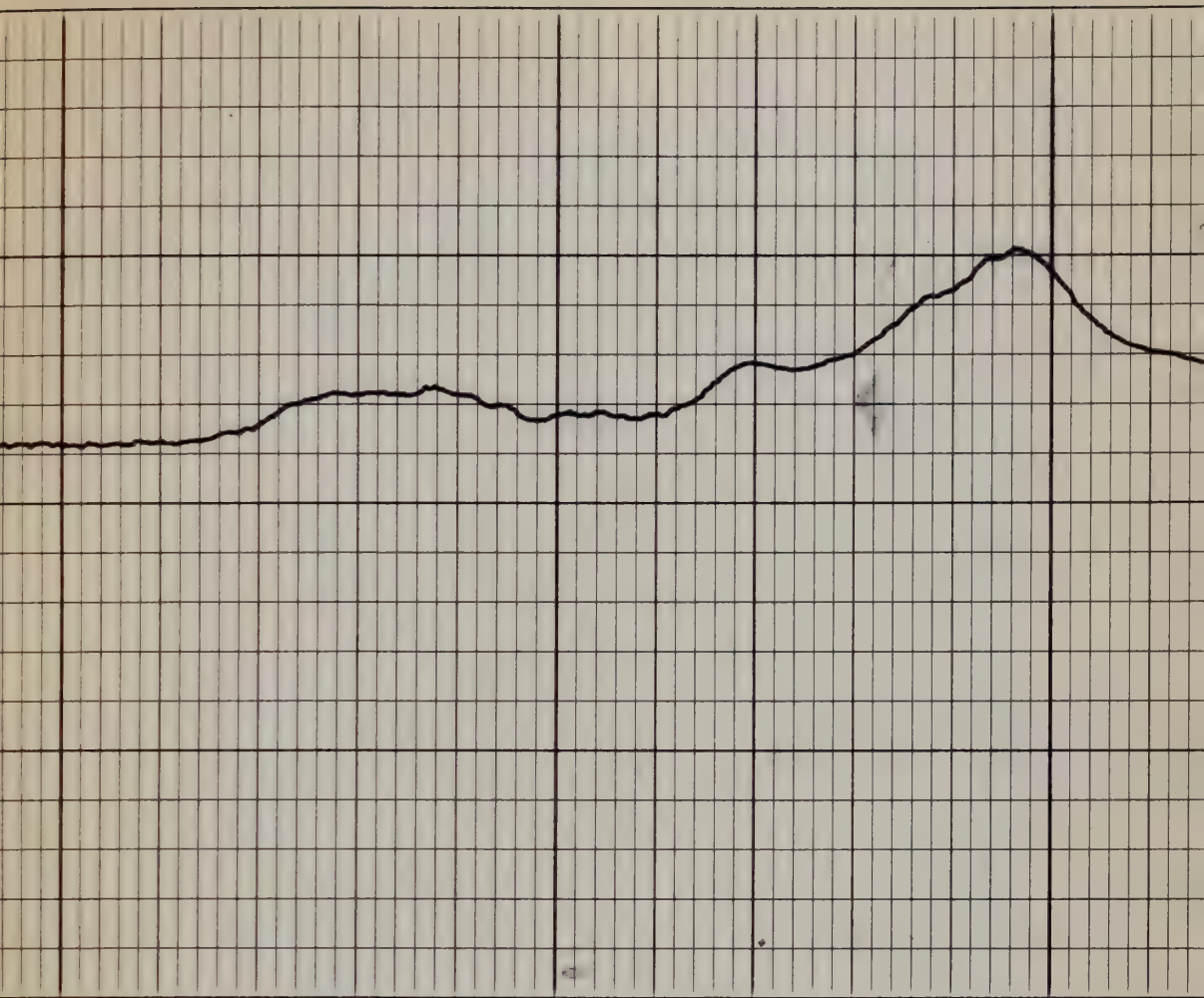
TEMPERATURE
° F

Casing

85 90 95

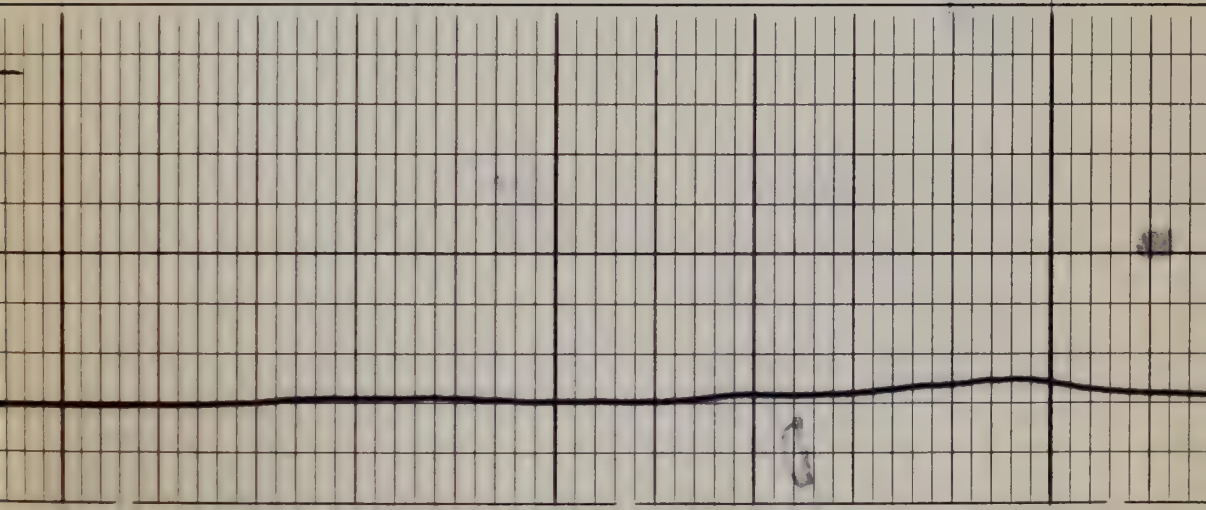
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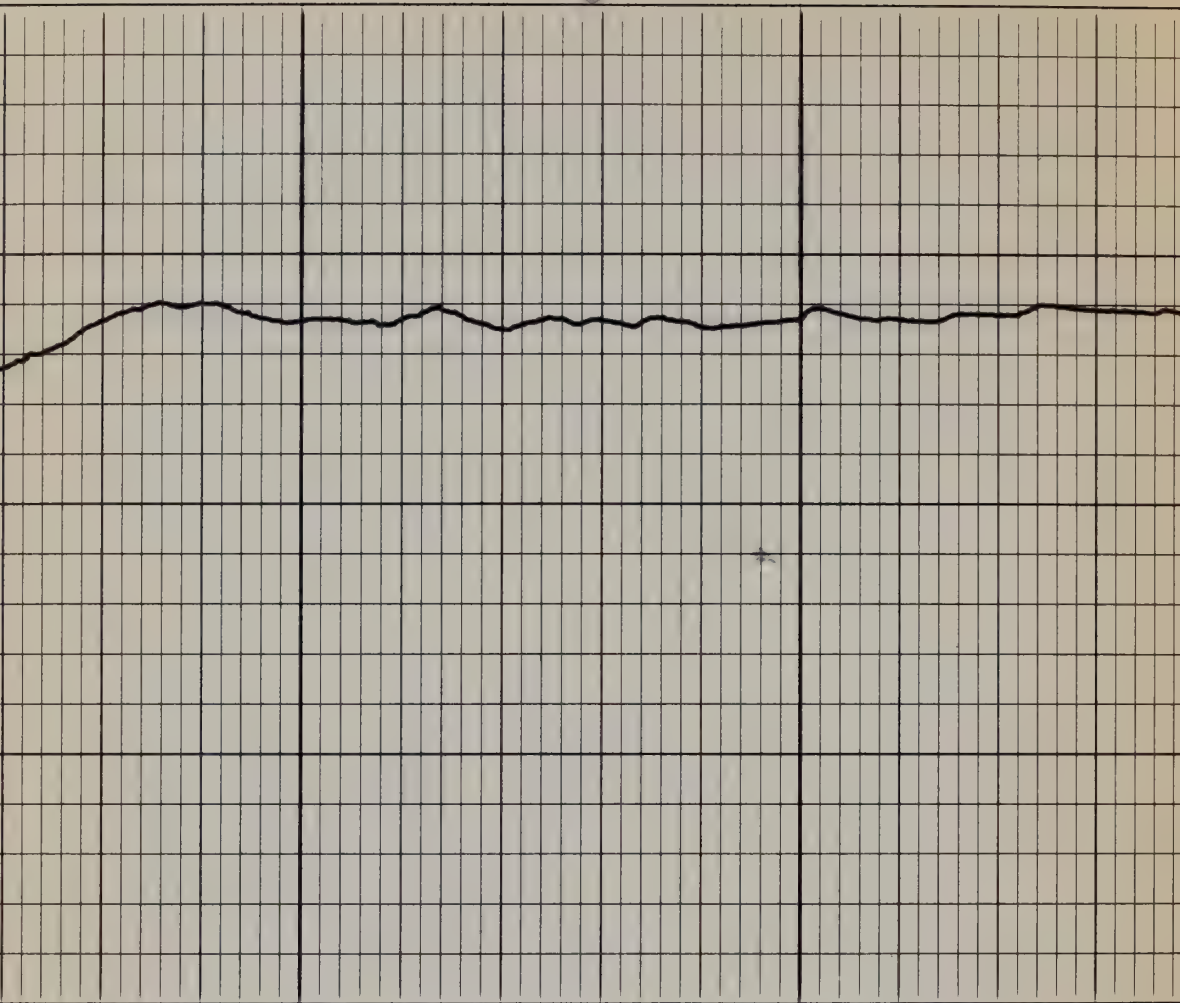




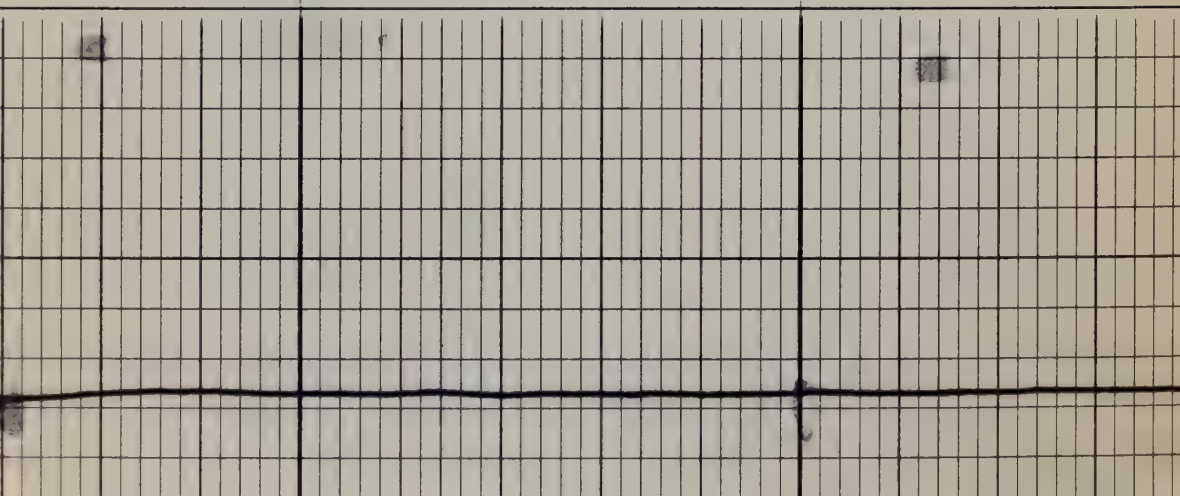
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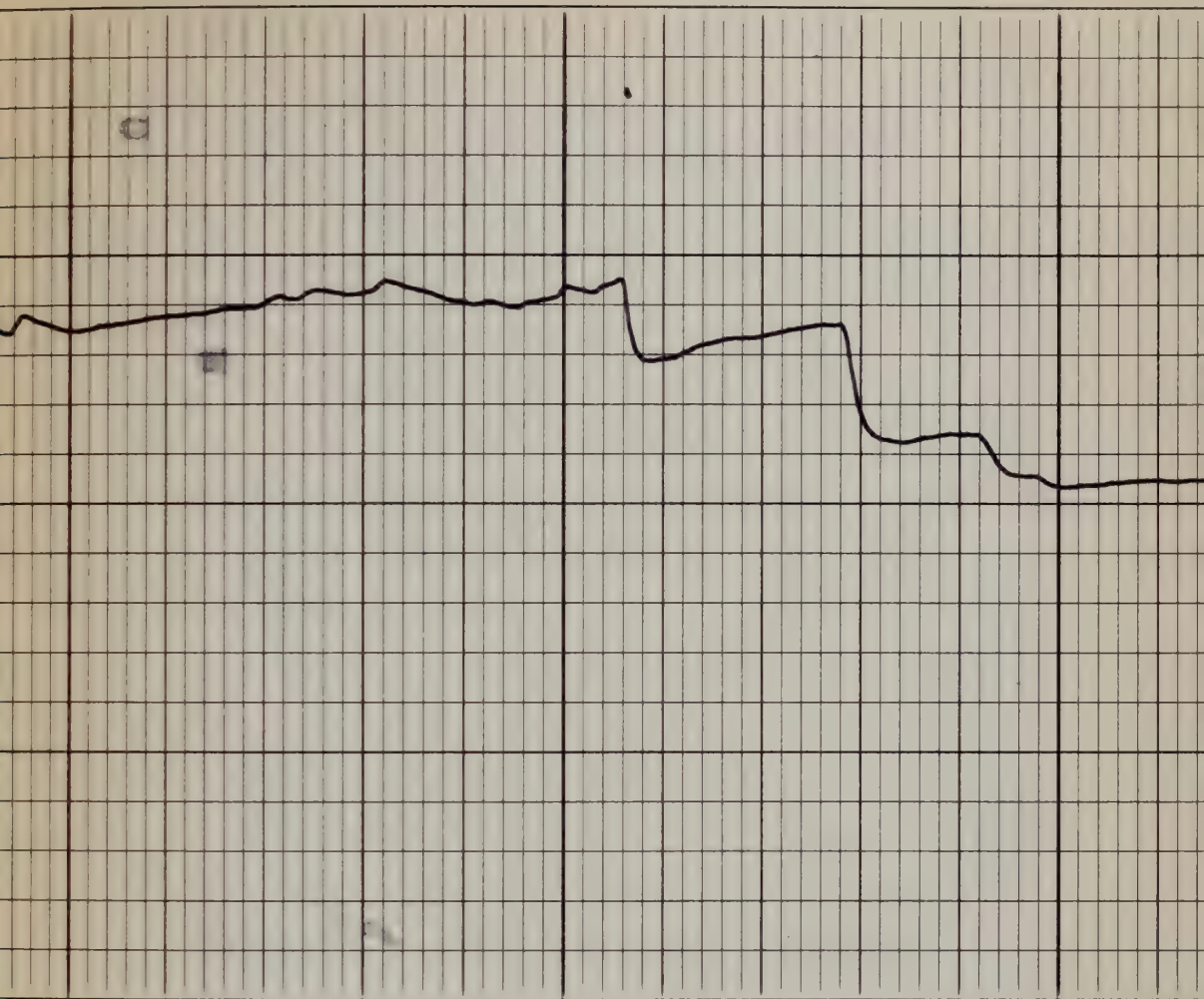
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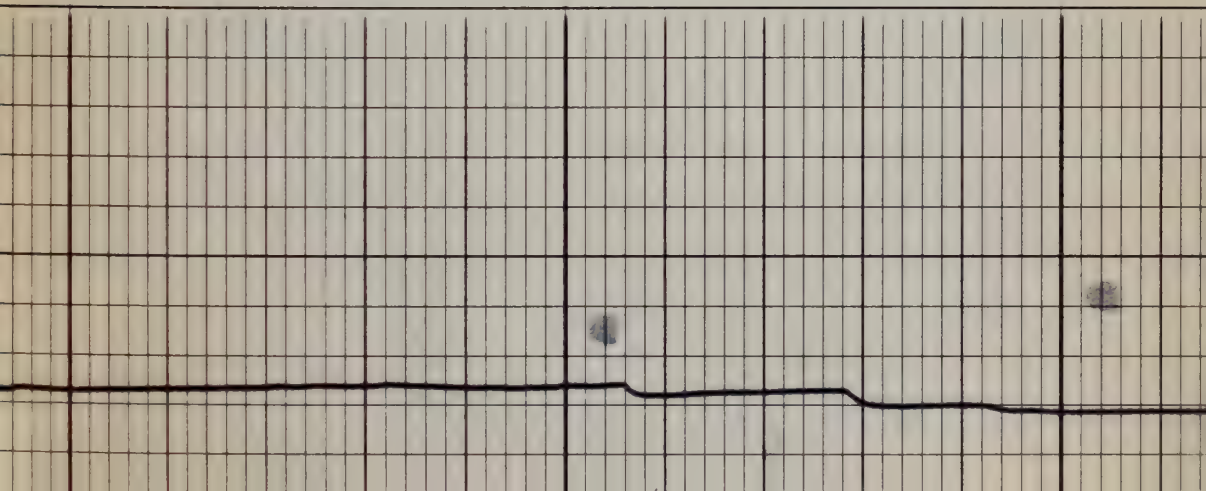


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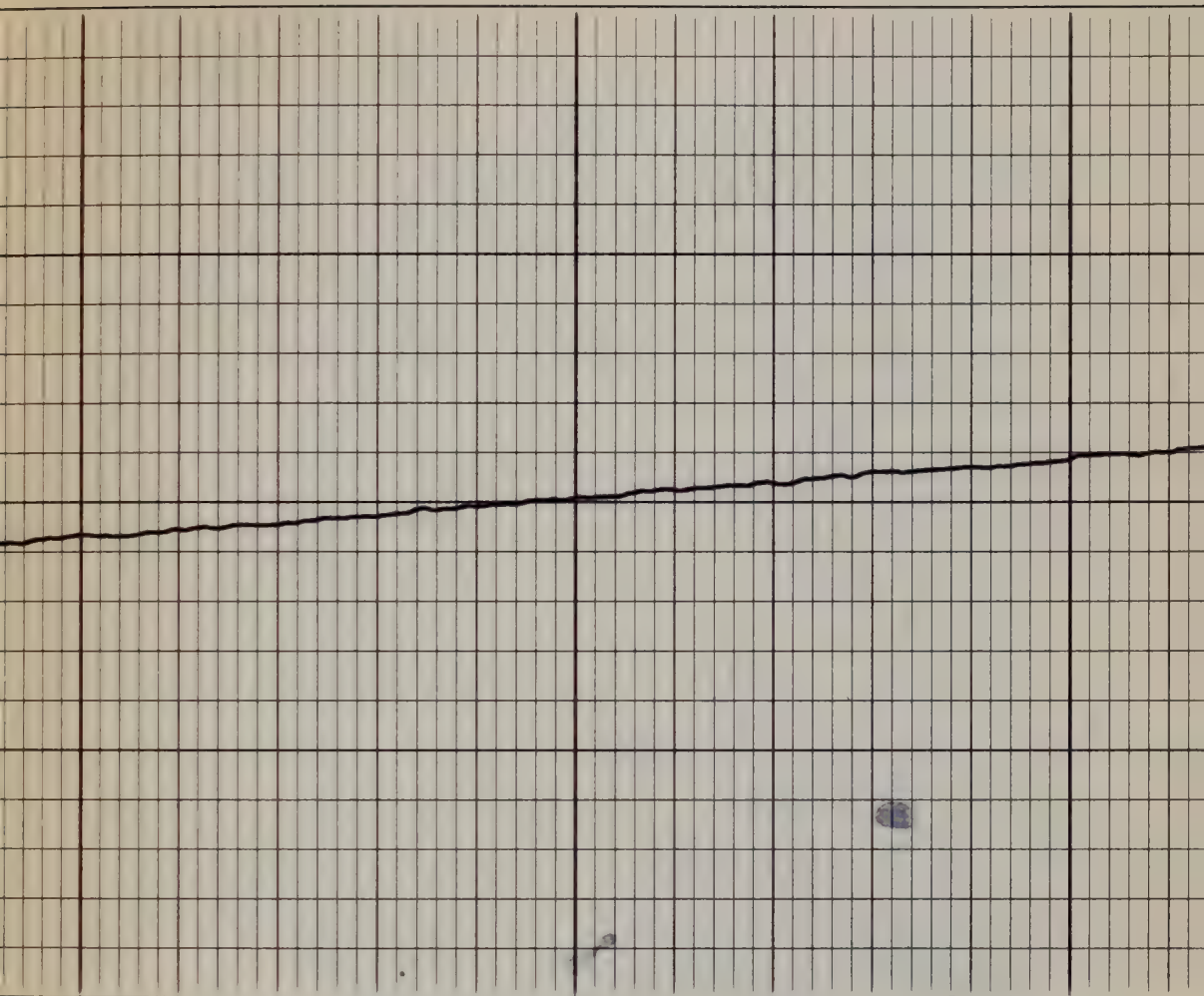


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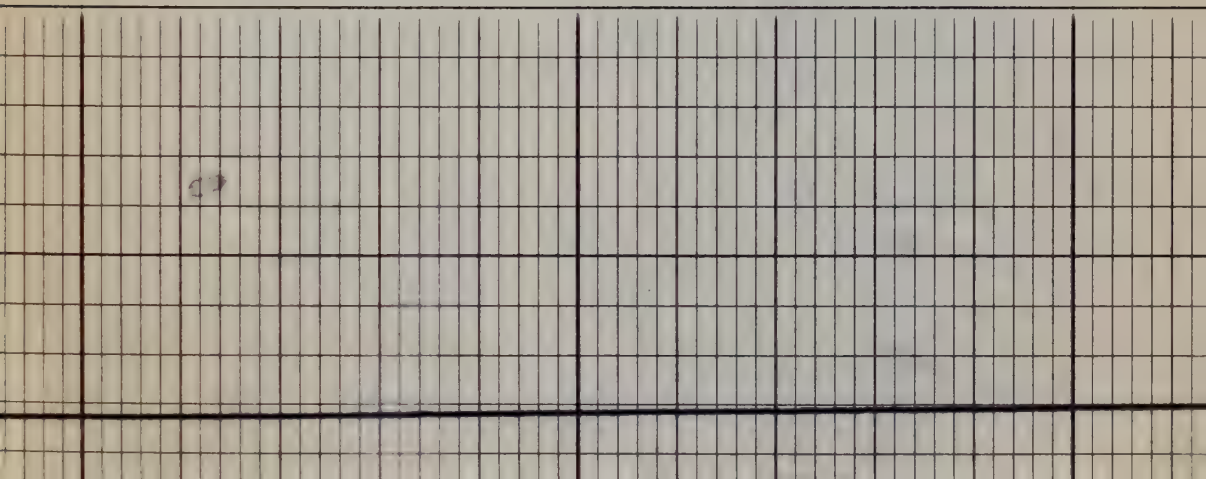
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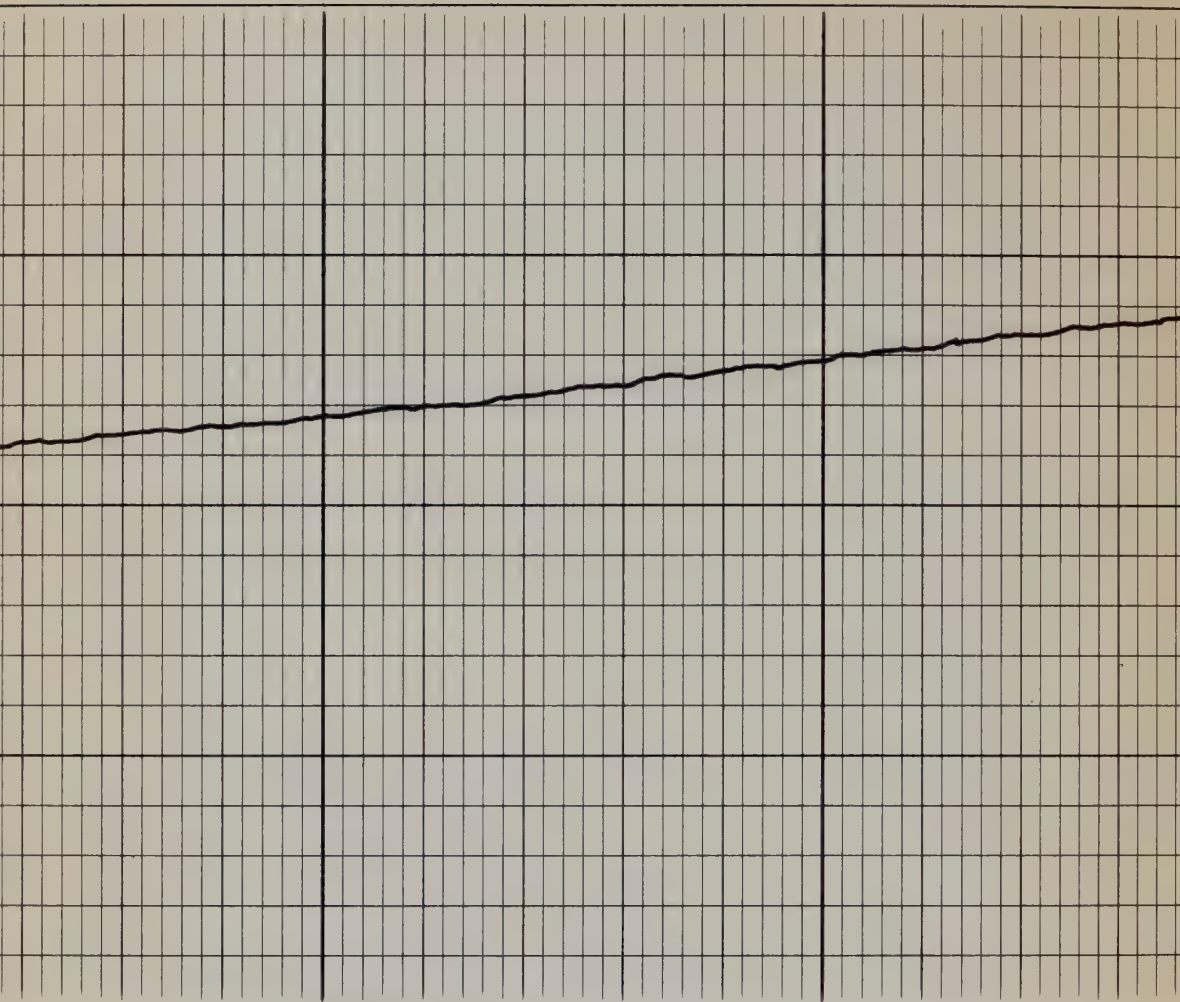
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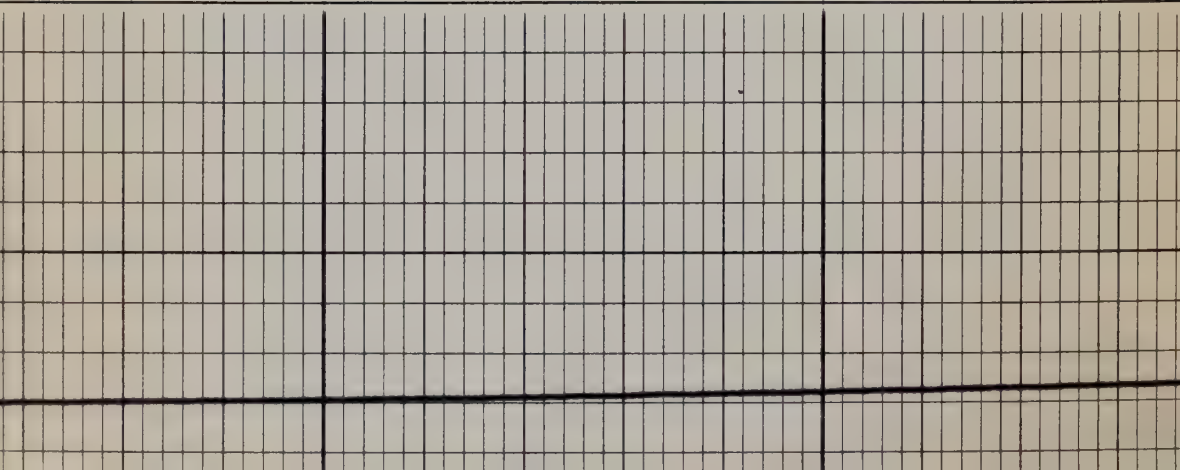
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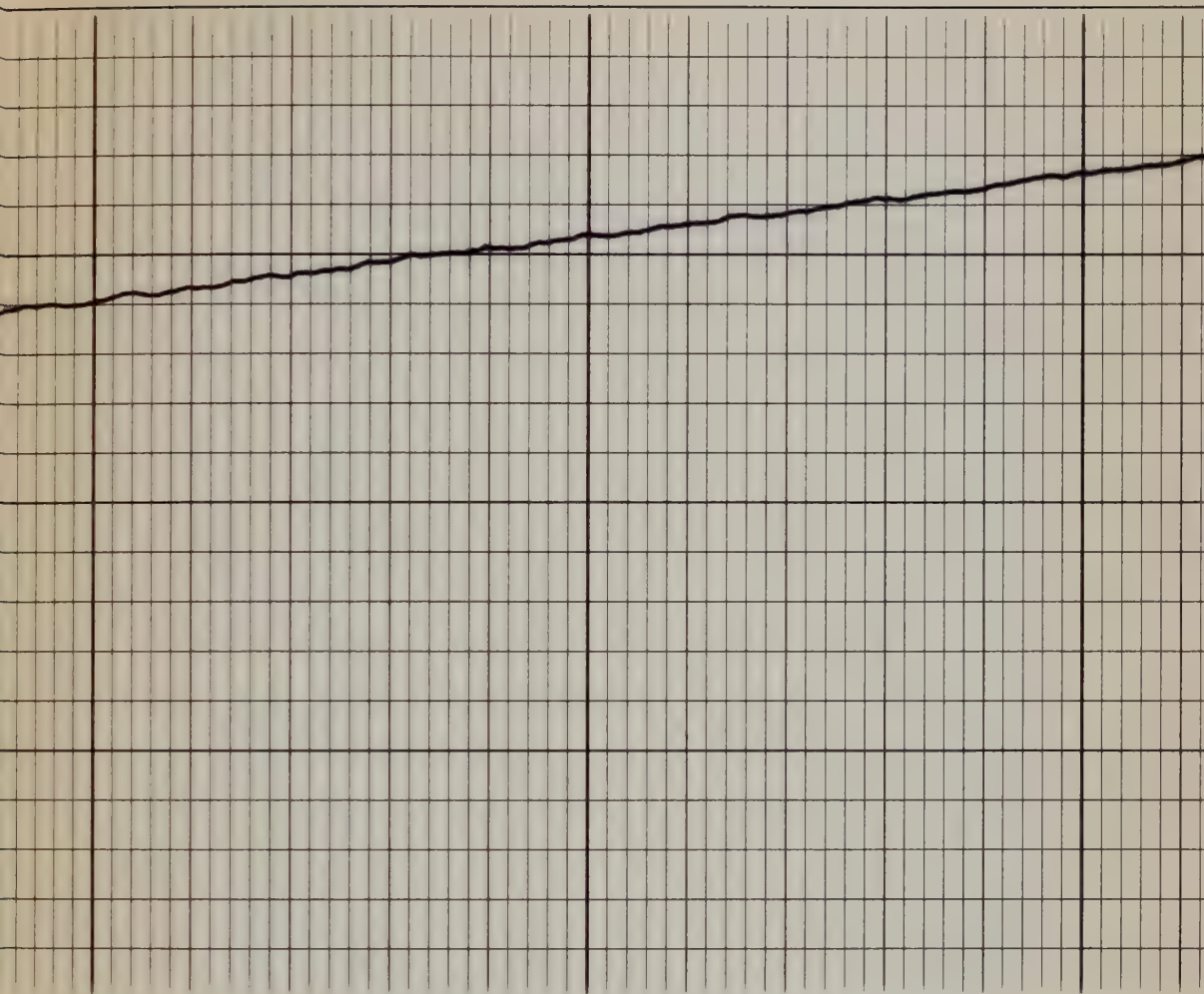
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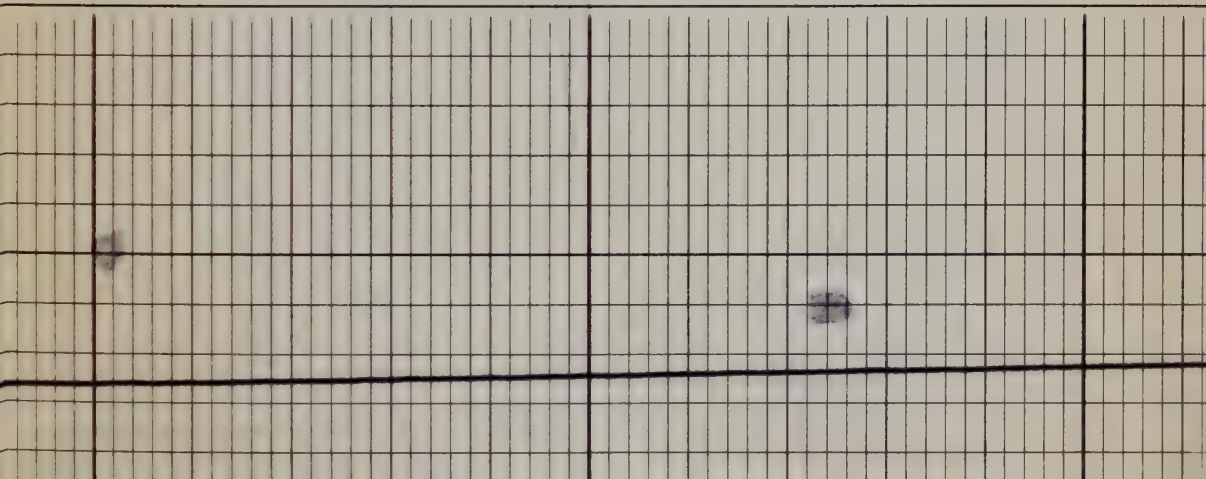


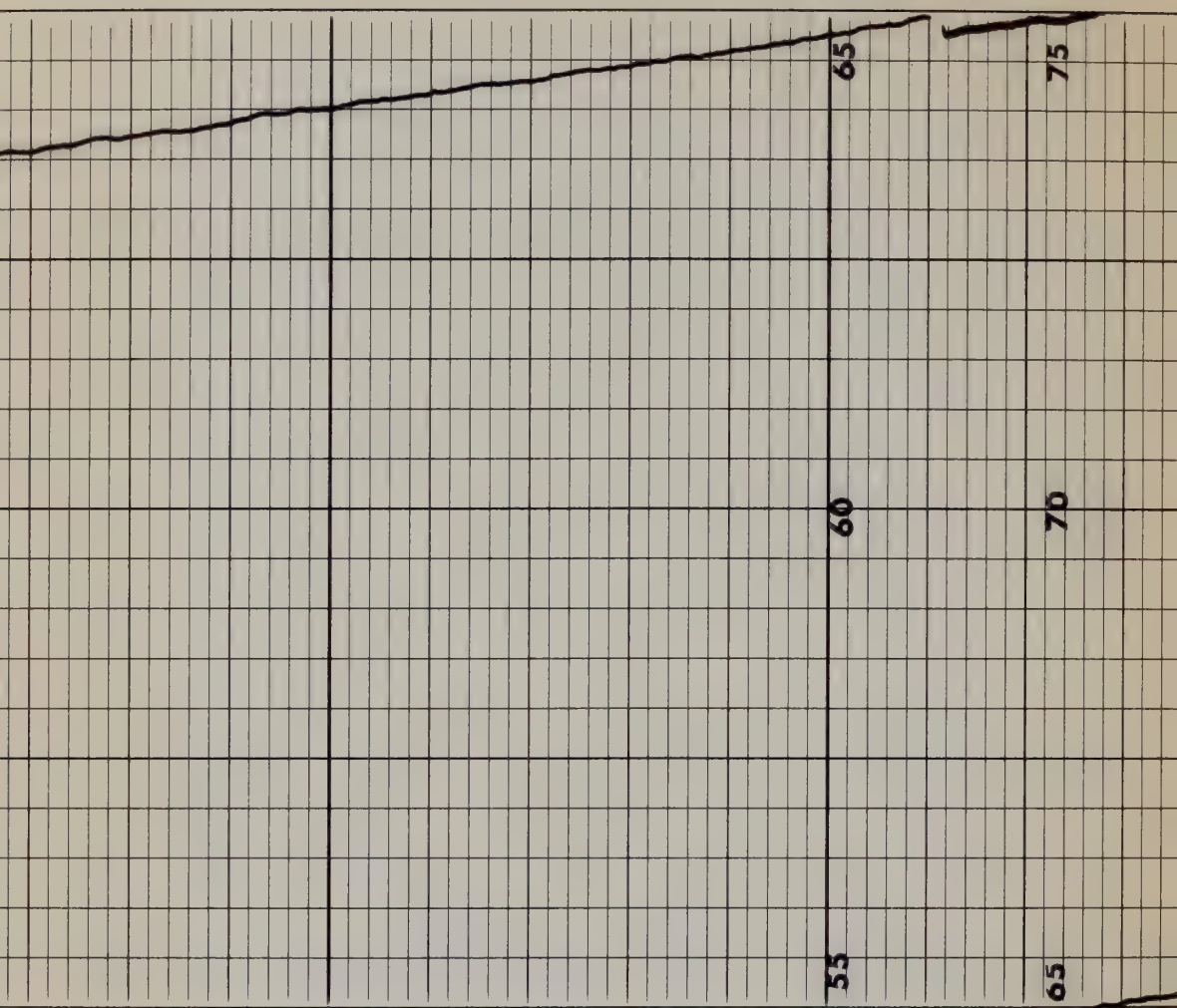
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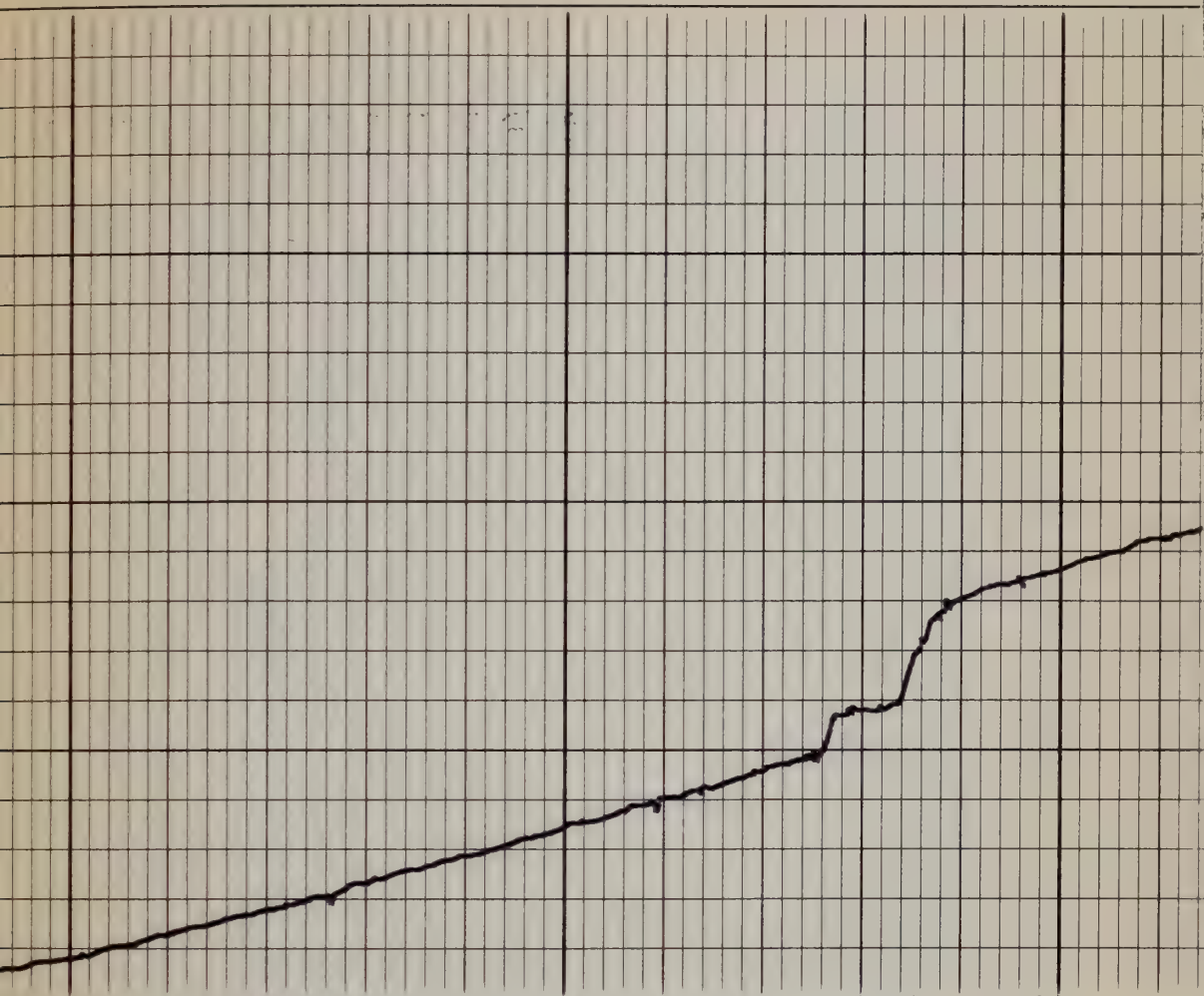


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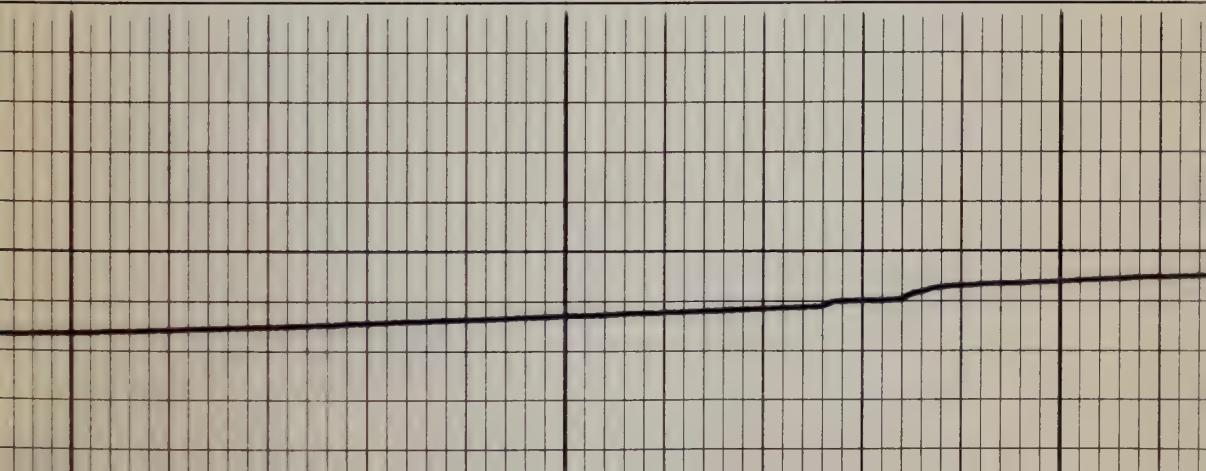


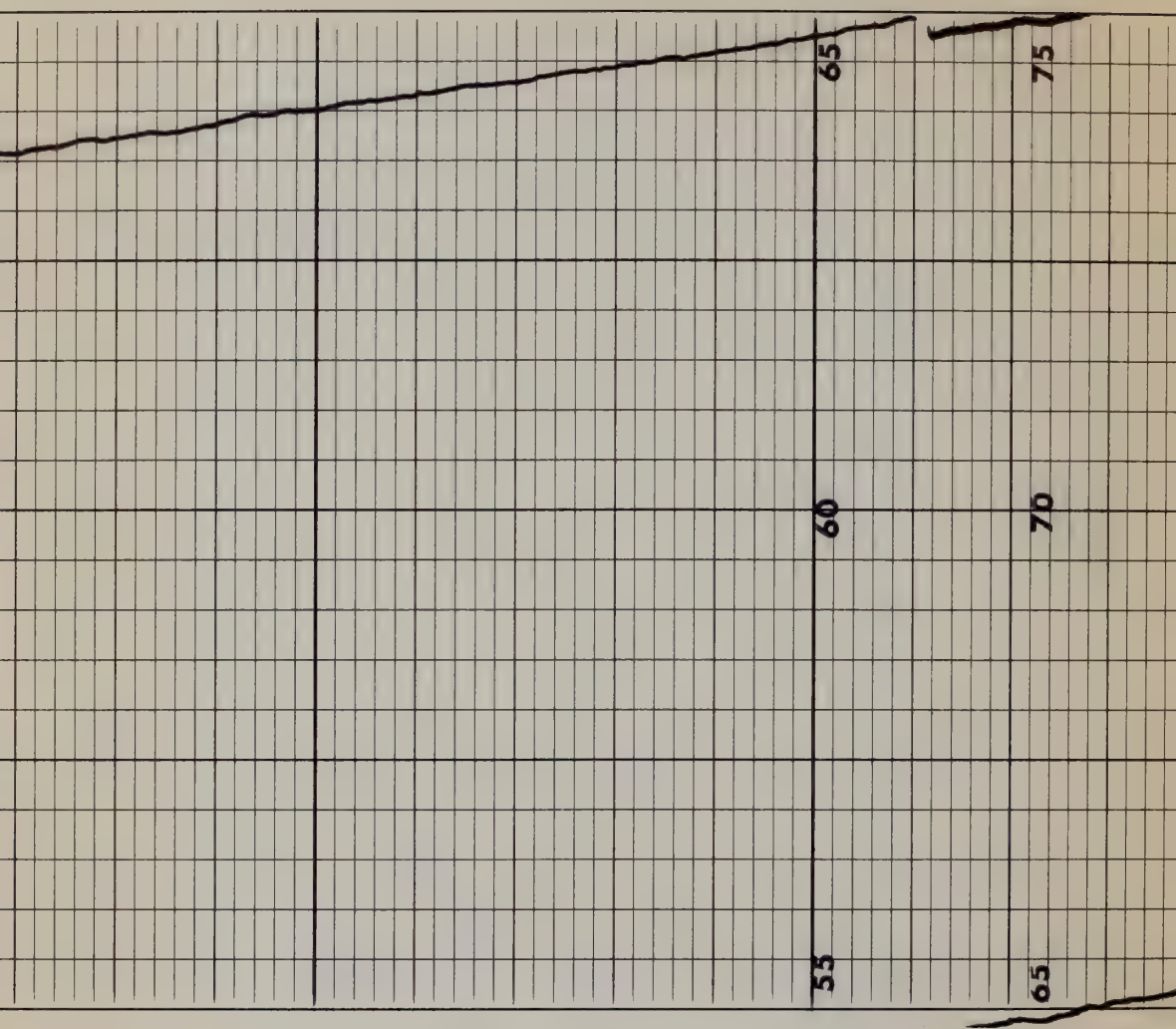
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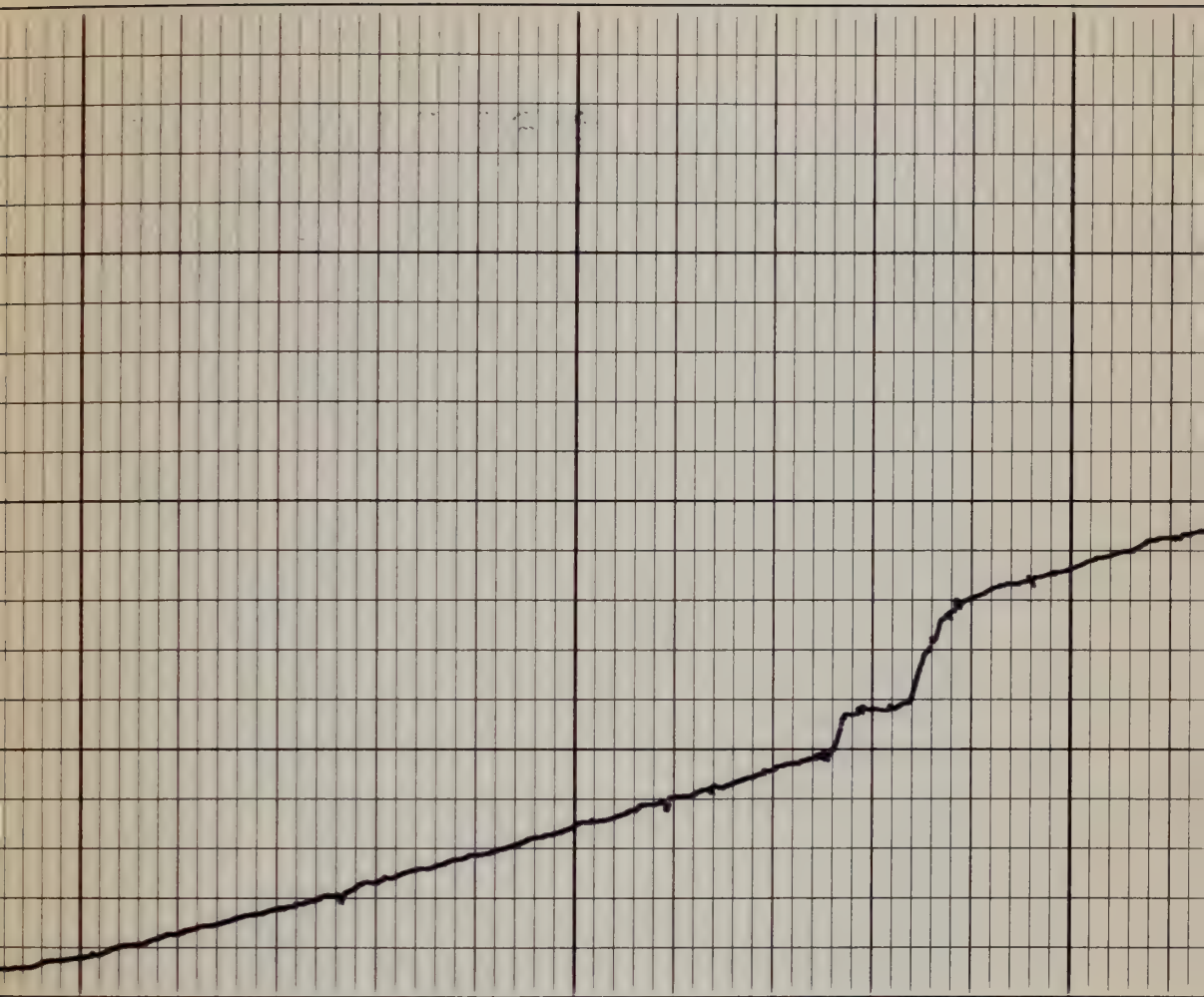
1100

1200



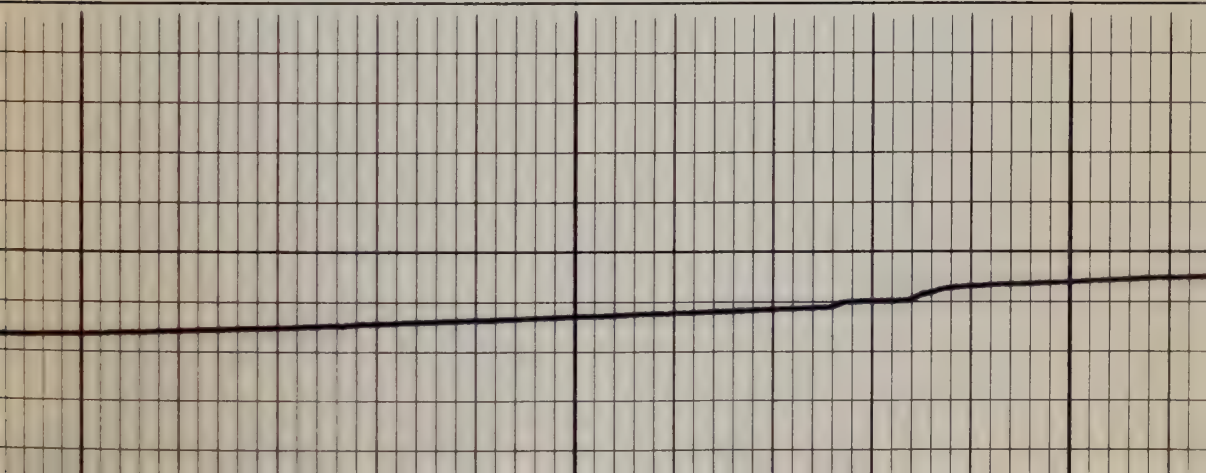


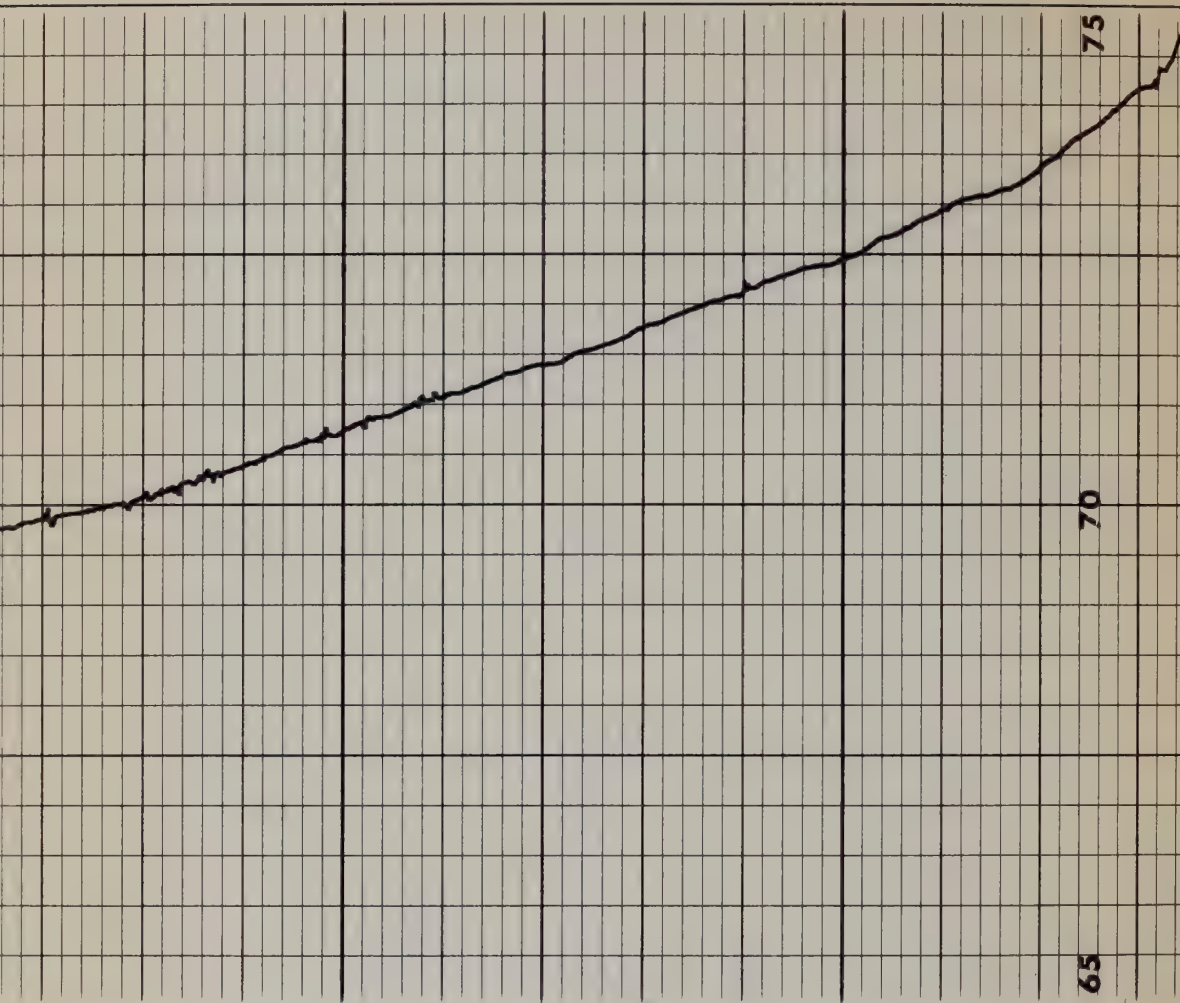
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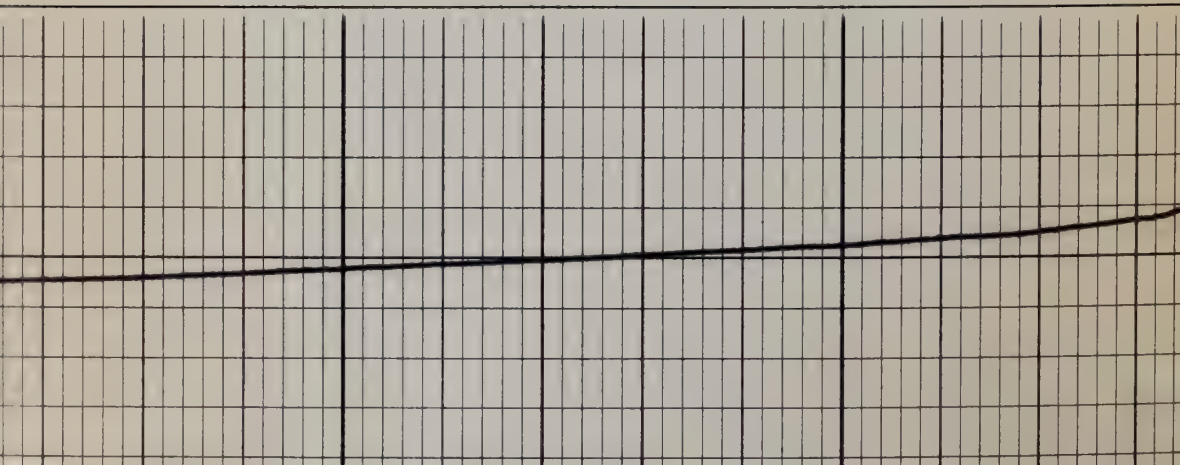
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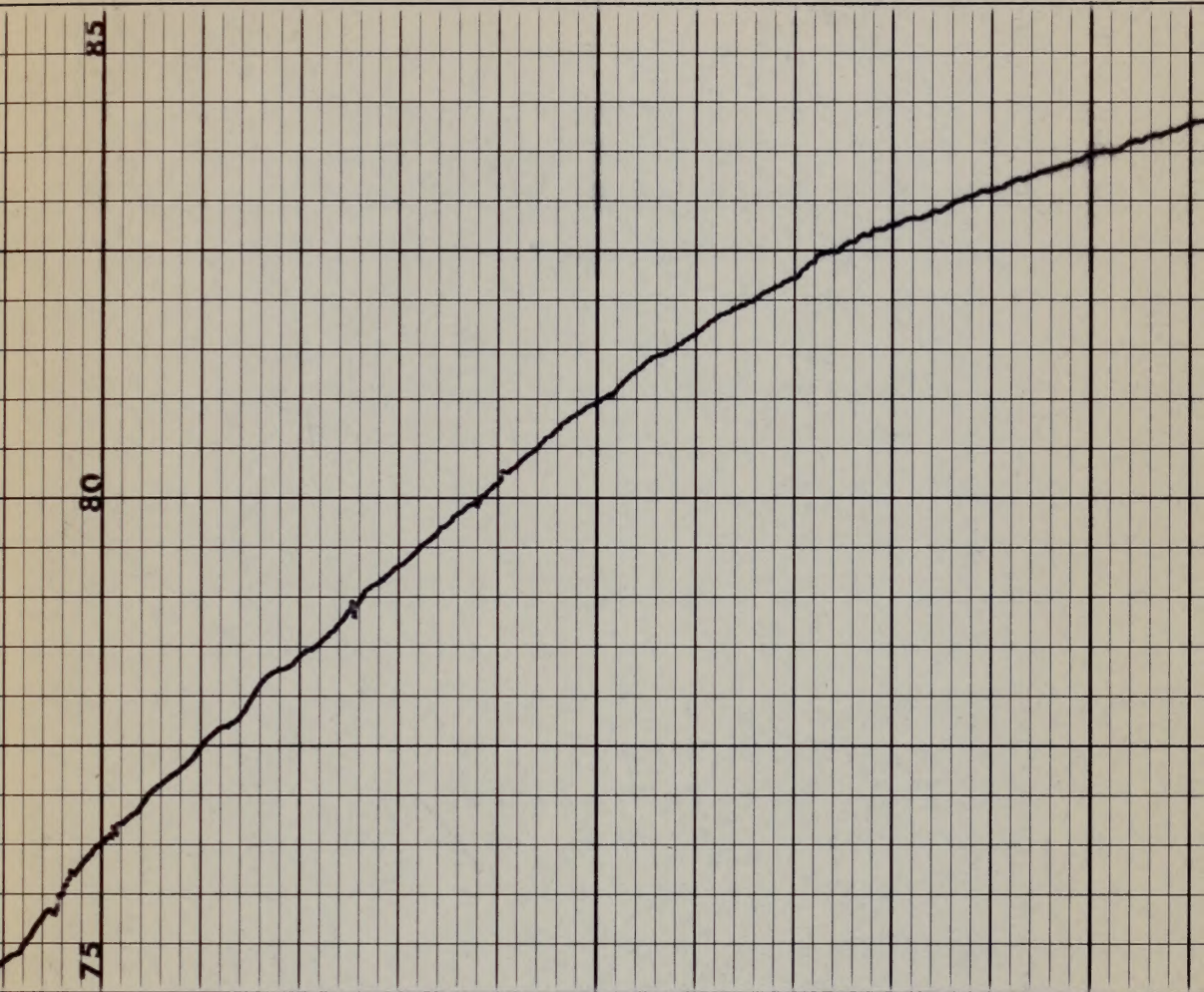
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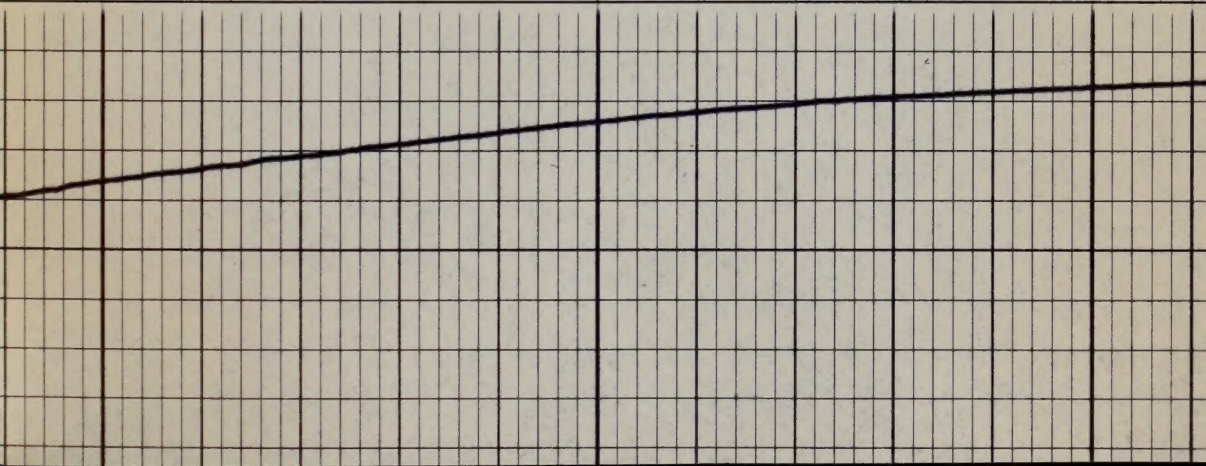


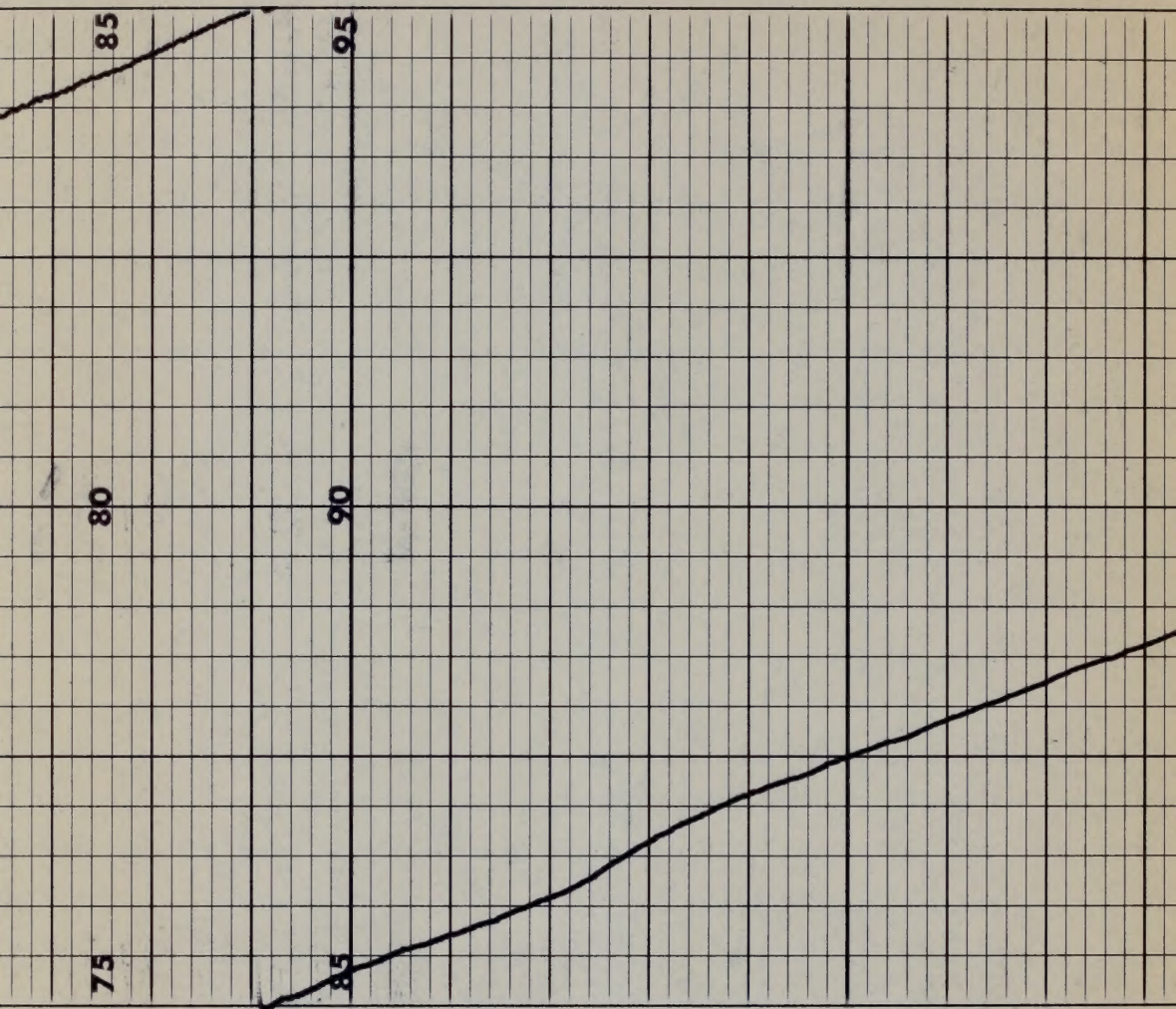
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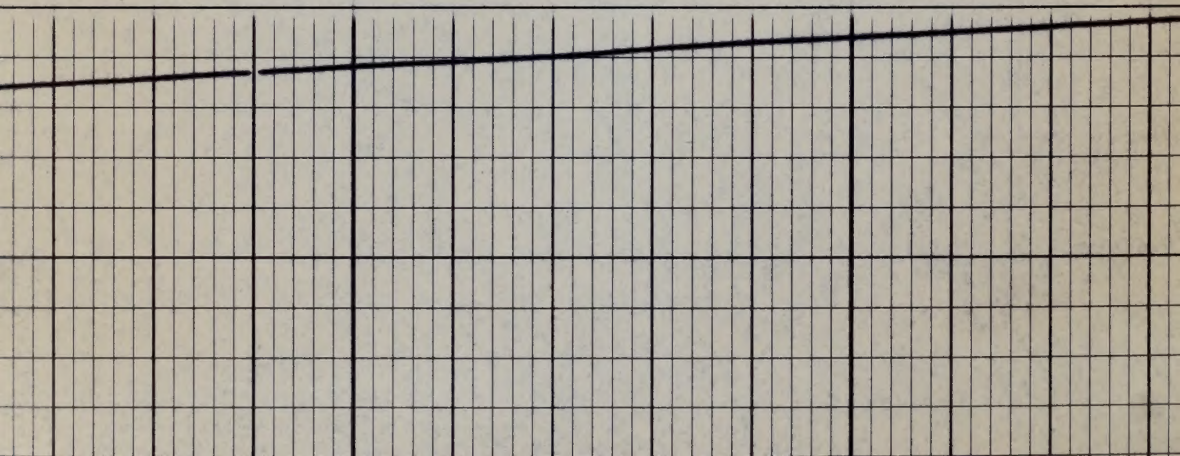


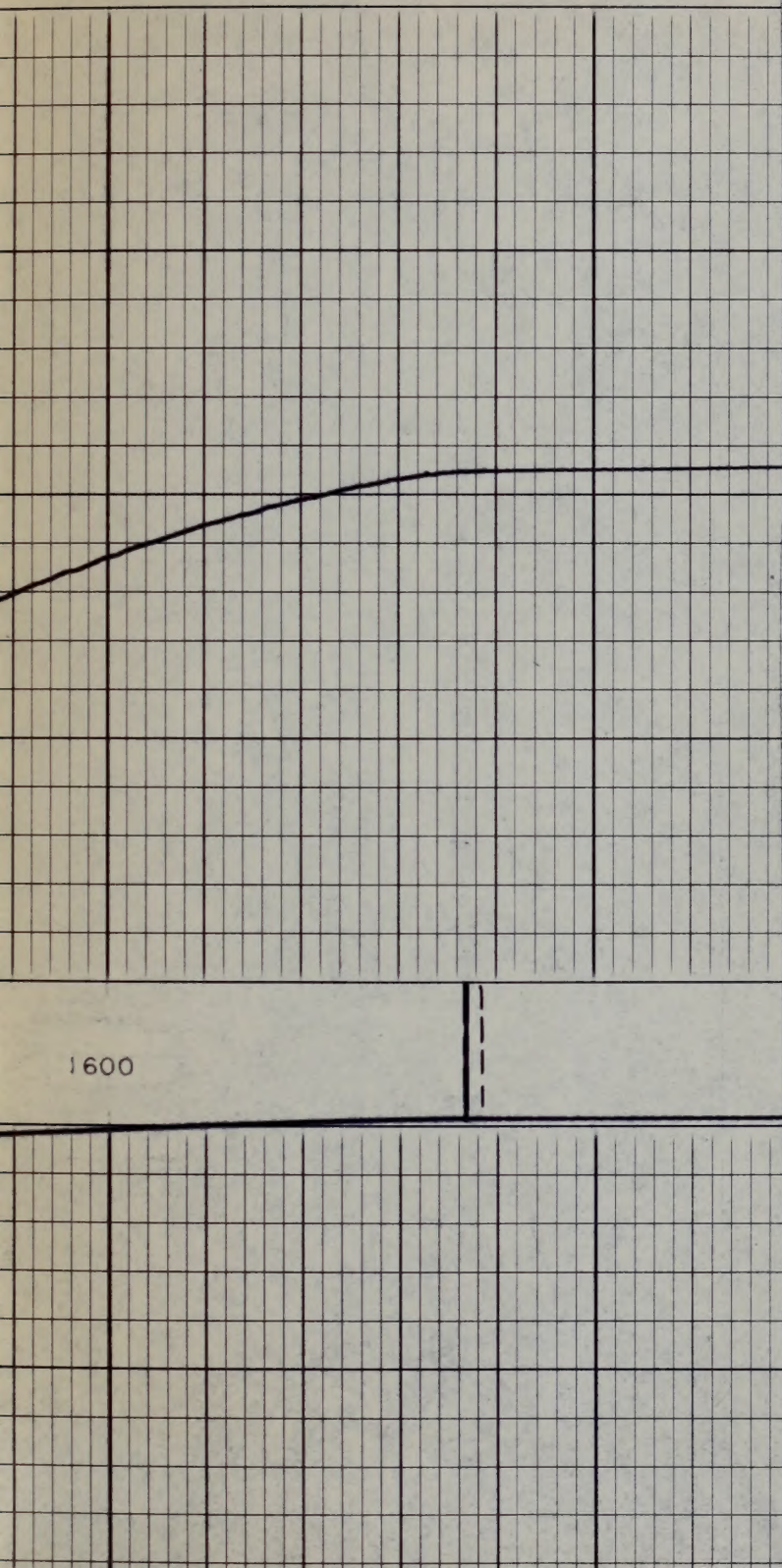
1400





1500





1600

COMPANY THE ATLANTIC RICHFIELD COMPANY

WELL AQUIFER TEST NO. 1-B

FIELD -----

COUNTY RIO BLANCO STATE COLORADO

Elev:

KB ----
DF ----
GL 6909

